
Soil Survey

Dade County Georgia

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SOIL SURVEY OF DADE COUNTY, GEORGIA

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INTRODUCTION

The soil survey map and report of Dade County, Ga., are intended to convey information concerning the soils, crops, and agriculture of the county to a wide variety of readers.

Farmers, landowners, prospective purchasers, and tenants ordinarily are interested in some particular locality, farm, or field. They need to know what the soil is like on a certain piece of land, what crops are adapted, what yields may be expected, and what fertilization and other soil-management practices are needed for best results. Many persons do not wish to read the entire soil survey

¹ The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.

² The Tennessee Valley Authority cooperated by supplying a part of the funds and materials used in this survey.

report, and they need not do so to obtain much of the information essential to their purpose.

A person interested in a particular piece of land should first locate it on the colored soil map accompanying the report. Then, from the color and symbol, the soil may be identified in the legend on the margin of the map. By using the table of contents, the reader can find the description of the soil type or types. Under each soil type heading is specific information about that particular soil. There is a description of the landscape, including the lay of the land, drainage, stoniness (if any), vegetation, and other external characteristics; and the internal or profile characteristics of the soil—its color, depth, texture, structure, and chemical or mineralogical composition. The description includes information about present land use, crops grown, and yields obtained and statements concerning possible uses and present and recommended management.

By referring to the section on Productivity Ratings and Land Classification the reader may get an idea of how the soil types compare, one with another, as to productivity for the various crops and their suitability for the production of crops or for other uses. Further ideas concerning land use and soil management can be obtained from the section dealing with those subjects.

For the person unfamiliar with the county or area, there is a general description of the area as a whole in the first part of the report. Geography, physiography, regional drainage, relief, vegetation, climate, population, transportation facilities, and markets are discussed. A brief summary at the end gives a condensed description of the area and important facts concerning the soils and agriculture.

The agricultural economist and general student of agriculture will be interested in the sections on Agriculture, Productivity Ratings and Land Classification, and Land Uses and Management.

Soil specialists, agronomists, experiment station and agricultural extension workers, and students of soils and crops will be interested in the more general discussion of soils in the section on Soils, as well as in the soil-type descriptions. They also will be interested in the sections on Productivity Ratings and Land Classification and Land Uses and Management.

For the soil scientist, the section on Morphology and Genesis of Soils presents a brief technical discussion of the soils and of the soil-forming processes that have produced them.

COUNTY SURVEYED

Dade County is in the extreme northwest corner of Georgia (fig. 1). Trenton, the county seat, is about 19 miles southwest of Chattanooga, Tenn. The total area of this county is 176 square miles, or 112,640 acres.

Physiographically, Dade County constitutes part of the Appalachian Plateaus extending from central Alabama to southern New York. The most prominent features are two parallel mountain ranges—Lookout and Sand Mountains—which take northeast and southwest courses and conform to the strike of the geologic formations. These mountains are separated by Lookout Valley, which ranges from 3 to 6 miles in width.³ Lookout Mountain, in the eastern

³ U. S. Geological Survey. Ringgold Georgia-Tennessee topographic sheet.

part of the county, has an altitude ranging from 1,700 to 2,200 feet above sea level; * Sand Mountain, in the northwestern quarter, ranges from 1,300 to 1,600 feet in altitude. The altitude of Lookout Valley ranges from 680 feet, where Lookout Creek crosses the Georgia-Tennessee line, to 1,300 feet on Pudding Ridge and 1,200 feet on numerous chert ridges throughout the valley. All these chert ridges are narrow and steep, having a decidedly broken relief. They have a northeast and southwest trend, parallel with the higher mountains. Fox Mountain is apparently an isolated remnant of Sand Mountain. It has essentially the same general elevation and is capped with similar resistant sandstone and conglomerate. Slopes to Lookout Valley from all the mountains are steep and are cov-

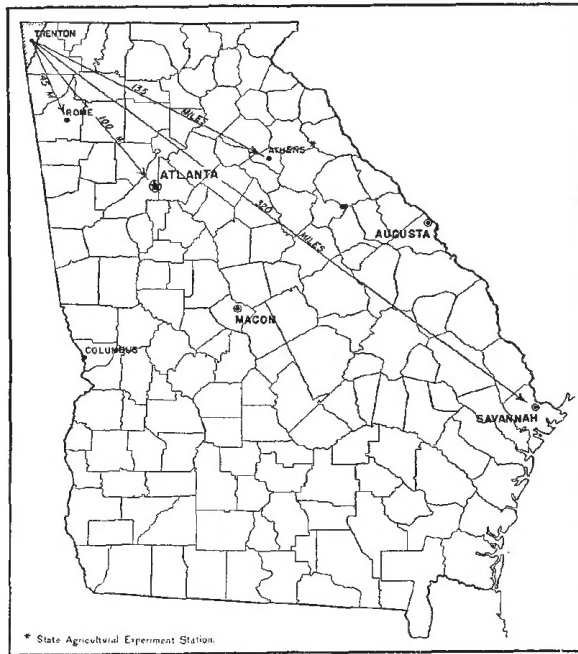


FIGURE 1.—Sketch map showing location of Dade County, Ga.

ered with large rock fragments that range from 5 to 40 feet in diameter.

The relief of both the mountains and the valleys is the result of weathering in conjunction with stream erosion where the formations vary widely in their resistance. For instance, the resistant chert beds of the valleys cap the higher ridges; whereas the limestone has gone largely into solution and the shale has been cut away. In the mountains the thick beds of sandstone and conglomerate occupy the higher parts, and the less resistant, thinly bedded, interstratified sandstone and shale material has been eroded away by stream waters.

Lookout Valley is underlain by limestone and chert formations

⁴ U. S. Geological Survey. Stevenson Alabama-Georgia-Tennessee topographic sheet.

with some shale, sandstone, and iron ore. Fort Payne⁵ chert formation of the Mississippian series is the most extensively developed. Lookout and Sand Mountains are capped mainly with Walden sandstone, which includes some conglomerate and a little interstratified shale. The upper slopes are occupied mainly by Lookout sandstone, which includes some shale and a little coal. Both Walden and Lookout sandstones belong to the Pennsylvanian series. Bangor limestone occupies the lower slopes of Lookout and Sand Mountains, and Pennington shale lies between Lookout sandstone and Bangor limestone. Bangor limestone and Pennington shale belong to the Mississippian series.

Drainage waters of Dade County flow largely eastward from Sand Mountain and westward from Lookout Mountain to Lookout Creek. This creek receives all the drainage waters of Lookout Valley and flows northeastward to the Tennessee River. In the extreme northwest corner of the county waters drain into Nickajack Creek, which flows northwestward to the Tennessee River. Other small streams of Sand Mountain flow westward to the same river. Drainage of the extreme southern and southeastern parts moves southward to the Coosa River.

In Lookout, Sand, and Fox Mountains there are very few perennial streams but numerous small intermittent ones. Springs that flow out at contacts between the shale and sandstone or shale and conglomerate are the main sources for the water supply of the former, whereas springs and the run-off after or during rains furnish the waters for the latter. Many mountaineers on Sand Mountain get their water supply from springs, and the rest get their supply from wells. In the valleys numerous perennial springs emerge from contacts between limestone and shale. These supply water for the towns of Trenton and Rising Fawn and for most of the farm homes. Wells also supply water in the valleys. Probably half of the mountaineers have to haul water to supplement the home supply during dry periods, but in the valleys few homes ever have an inadequate supply.

Dade County originally was completely covered by a mixed deciduous and coniferous forest.

In the early part of the nineteenth century,⁶ northwestern Georgia was neutral ground between the Cherokee Nation and the State of Georgia. In 1831 the old land lot survey was made. This divided the land into districts 9 miles square and further subdivided the districts into 160-acre lots. In 1835 the Indians relinquished all claims to the territory by act of treaty, and in 1838 Dade County was formed. Prior to the treaty, a few scattered settlers lived in Lookout Valley, but agriculture developed very little until the Indians withdrew.

The majority of the early settlers were of Anglo-Saxon stock and came from Virginia, the Carolinas, Tennessee, and Georgia. Many of the white inhabitants now living in the county are descendants of the early settlers. According to the 1930 census, the population of Dade County is 4,146, of which 3,940 are white, and 206 are Negro. All are rural. The density of population is recorded as 22.3 per square mile. The distribution of population in the valley is fairly even, but large

⁵ SMITH, RICHARD V. SHALES AND BRICK CLAYS OF GEORGIA. Ga. Geol. Survey Bul. 45, 348 pp., illus.

⁶ Information on the early history of Dade County was compiled by the Trenton High School students under the supervision of M. Hayes, principal, who furnished it for this report.

tracts of land in the mountains, owned by timber companies, are almost uninhabited.

Trenton, the county seat, and Rising Fawn are the chief trading and shipping centers. Railroad facilities, however, at Sulphur Springs, New England, Morganville, Wildwood, and Hooker make these places distributing and shipping points.

Transportation facilities are only fair. The Southern Railway and United States Highway No. 11 cross the county in a northeast-southwest direction, following the general course of Lookout Creek. The Nashville, Chattanooga & St. Louis Railway crosses the northern part of the county from east to west. Roads improved by gravel and chert are in many parts of Lookout Valley, and one such road extends west from Trenton across Sand Mountain into Alabama. Other public roads in the mountains are mostly graded dirt roads. Rural mail routes can easily be reached from most homes, but some of the mountaineers live 6 or 7 miles from a rural free delivery route.

Agriculture is the sole industry of Dade County except for a planing and sawmill at New England that furnishes employment to about 50 men, another at Trenton employing 12 men, a score or more of small portable sawmills, and a small coal mine that gives employment to 2 or 3 men.

CLIMATE

Dade County has a continental climate characterized by long summers and short mild winters. Although periods of freezing occur in December, January, and February, they seldom last more than a few days. Snow is rare. Outdoor work can be performed most of the winter. The temperature is sufficiently mild for fall-sown oats, wheat, and rye, as well as vetches, crimson clover, Austrian Winter peas, and other growing crops. Turnips, cabbage, collards, lettuce, beets, onions, and radishes are grown during the winter and may escape injury from freezing. Owing to the higher altitudes, the temperature on Lookout and Sand Mountains is a little lower, both in summer and winter, and the growing season is a little shorter than in the valleys. The average frost-free season of 212 days, as recorded by the United States Weather Bureau station at Chattanooga, Tenn., extends from March 30 to October 28. Frost has been recorded, however, as late as May 14 and as early as September 30. The growing season is suitable for cotton on the friable well-aerated soils, but the heavier textured and poorly drained soils warm too late in the spring for cotton to mature before serious boll weevil infestation sets in. Sometimes crops on the heavier soils are damaged by frosts.

The average annual rainfall is 51.61 inches. In general, the rainfall is well distributed throughout the year but is heaviest in the spring and summer when the demand for moisture by growing crops is greatest. It is lightest in the fall, thus favoring ripening and harvesting. Records of the station at Chattanooga show in the period 1879-1931 six excessively wet growing seasons when the total precipitation for May, June, and July, normally 12.20 inches, exceeded 18 inches, and six severe droughts when the rainfall was less than 7 inches.

The rather wide differences in the length of the frost-free season in different parts of Dade County are due to location in respect to elevation and air drainage. It is well known that the tops and upper slopes

of ridges and the upper steep valley slopes of Sand, Lookout, and Fox Mountains, where the cold air drains off down the slopes, are not affected by many of the severe killing frosts that occur on the floors of the valleys and lower slopes, where the locations are favorable for the accumulation of the cold air from the ridges and upper slopes. Heavy fogs sometimes blanket certain parts of the larger valleys as well as a few of the smaller ones. These fogs modify the low temperatures so that crops escape some of the later killing frosts in the spring and the earlier ones in the fall.

In addition to danger of late frost, heavy spring rains delay planting and germination of seed in soils with poor drainage, as the water-soaked soils remain very cold until late in spring.

As a rule, moderate western winds prevail, although occasionally storms reach destructive velocities so that corn, wheat, and sorghum are blown down. Hail sometimes accompanies thunderstorms and damages cotton, corn, and other crops in small areas.

Table 1, compiled from the records of the Weather Bureau station at Chattanooga, Tenn., gives important climatic data applicable to this county.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Chattanooga, Hamilton County, Tenn.

[Elevation 808 feet]

Month	Temperature			Precipitation			
	Mean	Absolute max-imum	Absolute min-imum	Mean	Total amount for the driest year (1904)	Total amount for the wettest year (1929)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December.....	43.3	75	3	5.13	4.12	2.89	1.5
January.....	41.2	76	-7	5.26	2.58	5.72	2.5
February.....	44.1	79	-10	4.88	2.08	5.83	2.2
Winter.....	42.9	79	-10	15.27	8.78	14.44	6.2
March.....	51.2	89	2	5.78	5.81	10.80	.8
April.....	60.3	92	25	4.85	1.67	6.70	.2
May.....	68.8	95	37	3.79	2.76	12.00	.0
Spring.....	60.1	95	2	14.42	10.24	29.50	1.0
June.....	75.4	100	39	4.16	1.92	4.39	.0
July.....	78.4	104	56	4.25	2.09	3.21	.0
August.....	77.5	101	54	4.03	5.03	.45	.0
Summer.....	77.1	104	39	12.44	9.04	8.05	.0
September.....	72.2	104	38	3.11	1.07	5.66	.0
October.....	61.9	92	26	3.01	.46	3.12	(1) .3
November.....	50.4	81	11	3.36	3.09	11.60	.3
Fall.....	61.5	104	11	9.48	4.62	20.38	.3
Year.....	60.4	104	-10	51.61	32.68	72.37	7.5

¹ Trace.

AGRICULTURE

After the Cherokee Indians withdrew from the county in about 1835, settlement was comparatively rapid in Lookout Valley. Subsistence crops were grown. Corn was the most important, as it has such a wide range of uses and could be grown with some success on all kinds of land. Wheat was ground into flour at local water-driven

mills. Cutting of timber and grazing of cattle and sheep on the open range were the chief evidences of development amid the virgin forests. Lack of roads discouraged farming on Sand Mountain before 1870 and on Lookout Mountain before 1900. Until 1850 Rome was the nearest market, but at about that time the Western & Atlantic Railroad was built from Atlanta to Ringgold. Thereafter, Ringgold became the main outlet for the produce of Dade County. In the early seventies approximately 800 men engaged in the iron industry near Rising Fawn, and 700 convicts worked a coal mine at Cole City. Lumbering was important after 1850, but it did not reach its climax until from 1910 to 1925.

Table 2 gives the acreages of the principal crops, and table 3 the value of agricultural products in stated years.

TABLE 2.—*Acreages of principal crops in Dade County, Ga., in stated years*

Crop	1870	1880	1890	1900	1910	1920	1934
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Corn.....	8,336	7,652	6,018	6,512	7,065	5,456	5,417
Cotton.....	32	181	8	108	854	1,637	1,163
Wheat.....	3,996	800	2,396	647	1,034	218	774
Oats.....	2,299	2,279	453	1,291	290	18	46
Potatoes.....		116	98	280	136	126	258
Sweetpotatoes.....	85	77	73	116	124	78	137
Market vegetables.....					34	120	185
Dry peas (mostly cowpeas).....			104	12	33	263	387
Dry edible beans (mostly soybeans).....			14	1		694	481
Peanuts.....		1	7		10	19	42
Sorgho for sirup.....		99	22	96	197	66	
Sorghums for silage, hay, and fodder.....					1,154	50	126
Hay.....	316	837	845	2,149	3,065	2,022	2,685
Timothy and clover, alone or mixed.....						319	59
Sweetclover and lespedeza.....						7	746
Legumes for hay.....					1,320	970	872
Grains cut green.....			302	437	486	81	229
Other tame hay.....			543	1,425	1,221	580	679
Wild hay.....					33	65	(¹)
	<i>Trees</i>	<i>Trees</i>	<i>Trees</i>	<i>Trees</i>	<i>Trees</i>	<i>Trees</i>	<i>Trees</i>
Apples.....		² 11,040	³ 30,782	26,533	11,398	³ 9,431	³ 5,197
Peaches.....		² 8,611	³ 10,452	34,628	14,407	³ 11,739	³ 9,259

¹ For forage only.

² Included in other tame hay.

³ Fruit trees are for the years 1890, 1900, 1930, and 1935, respectively.

TABLE 3.—*Value of certain agricultural products in Dade County, Ga., in stated years*

Product	1909	1919	1929
Cereals.....	\$95,823	\$282,034	\$114,769
Other grains and seeds.....	257	1,758	1,086
Hay and forage.....	29,318	106,613	32,672
Vegetables (including potatoes and sweetpotatoes).....	31,073	78,071	30,321
Fruits and nuts.....	12,341	14,504	17,735
All other field crops.....	24,258	112,370	81,151
Farm garden vegetables (excluding potatoes and sweetpotatoes).....			33,711
Honey and wax.....	441	2,189	1,208
Dairy products sold.....	4,691	13,708	17,322
Poultry and eggs produced.....	18,075	58,985	59,682
Wool shorn.....	571	1,236	339
Forest products for home use and for sale.....			21,398

¹ No wax reported in 1929.

According to the census reports, the leading crops of the county in 1879, named in the order of their acreages, were corn, wheat, and oats. Minor crops were hay, sweetpotatoes, rye, cotton, and barley.

With little change in yield per acre, the acreage of corn has gradu-

ally decreased from 1879 to 1934. The lowest acre yield recorded was 15.8 bushels in 1934, and the highest was 20.9 bushels in 1919.

Wheat was grown extensively in the past century, the largest acreage, according to the census, being in 1879. The acreage reached a minimum in 1929 but again showed some increase in 1934. The lowest acre yield was 5.5 bushels in 1899, and the highest was 8.8 bushels in 1934. Wheat is grown to more or less extent in all parts of the county but particularly on the heavier textured soils in the valley. Very little wheat is grown on the fine sandy loams that cap the mountains. Insects and rust usually injure the wheat, and frequently this crop is also injured by freezing and thawing of the soil during winter, which causes heaving and breaking of the roots.

Oats also were important during the last century, reaching a maximum acreage in 1879. The acreage decreased rapidly after 1909. The best acre yield of 18.9 bushels was for 1934 when only 46 acres were reported.

The present agriculture in this county consists of the production of corn, cotton, wheat, and lespedeza hay. In addition some potatoes, sweetpotatoes, turnip greens, apples, and peaches are grown.

Cotton is the principal cash crop. Both the climate and the character of some of the soils favor its production. Most of the cotton is grown on the silt loams in the valley or on the fine sandy loams and very fine sandy loams on the mountains. The lighter textured soils are best suited for the growing of cotton, because the cotton fruits earlier on these soils and before much damage is done by the boll weevil. Cotton is the basis for credit and loans. It allows a tenant farmer to obtain some cash for the growing of the crop. Cotton can be stored for a considerable time, if kept dry, without deterioration, and it can always be sold at some price. It has been one of the principal crops of the county for many years and most likely will continue to be until some other cash crop has been introduced or can be more profitably grown.

More or less corn is produced on practically all of the agricultural soils in all parts of the county. The alluvial soils in the first bottoms and the recent colluvial soils return high yields of corn without the addition of fertilizer. Corn occupies a much larger acreage than cotton, yet the amount produced is not sufficient to supply all the needs of farmers and others in the county. It is used mainly to feed work animals, to fatten hogs, and to grind into meal for home use.

Lespedeza is the principal hay crop, and a considerable acreage is devoted to the growing of velvetbeans, cowpeas, and soybeans. A small acreage is used for the growing of oats and peanuts, and some crimson clover is grown during the winter.

The production of apples and peaches are of some importance on Sand Mountain. On Lookout, Sand, and Fox Mountains, sweetpotatoes, potatoes, and turnips are grown for sale. Garden vegetables are produced in all parts of the county mainly for home use and some for sale in Chattanooga.

The number of hogs and pigs, according to the Federal census, increased from 1,569 on April 1, 1930 to 1,790 on January 1, 1935. Hogs are kept on every well-established farm, and a small revenue is derived from the sale of pork and pork products. Duroc-Jersey and Poland China are the most important breeds. A few farmers raise goats. The stock is rather inferior, and the goats browse on

sedges, shrubs, and the twigs of trees. In 1935 there were 566 mules and colts and 160 horses and colts.

Many of the farmers have flocks of 15 to 100 chickens. Barred Plymouth Rock and Rhode Island Red breeds are preferred by the average farmer, but a few specialize in White Leghorn. There are also a few flocks of turkeys, geese, and ducks. Most of the eggs, chickens, and turkeys are sold at the farm and carried by truck to Chattanooga.

The number of cattle on farms increased from 2,122 on April 1, 1930 to 2,384 on January 1, 1935, and some revenue is derived from the sale of beef cattle. A few small dairies are located in the northern part of Lookout Valley, and the milk and cream are transported by trucks to Chattanooga.

According to the census reports, the expenditure for fertilizer in 1909 was \$2,133 on 92 farms, an average of \$23.18 per farm; in 1919, \$10,042 on 296 farms, an average of \$33.93; and in 1929, \$13,890 on 273 farms, an average of \$50.88. Fertilizers commonly used for cotton are 2-10-2,⁷ 5-15-5, and 4-10-4. These are applied at the rate of 200 to 600 pounds per acre. From 200 to 800 pounds an acre of 4-8-6 are used for potatoes; 200 to 400 pounds of 4-8-6 for turnips; 300 to 400 pounds of 4-10-4 or 4-8-6 for cabbage; 200 to 300 pounds of 4-10-4 or 4-8-6 for bunch beans; and 200 to 400 pounds of 4-12-4 for tomatoes. Pulverized limestone or its equivalent in some other form of lime is used to a small extent. On all soils, lime is essential for good results with most legumes, and the yields of grain and other crops are increased through its use. The average acre application is approximately 2 tons of ground limestone.

In 1880, 58.9 percent of Dade County was in farms. At that time the average size of a farm was 171 acres. In the eighties and nineties interests were devoted to lumbering and mining. Consequently, in 1900 only about 43.9 percent of the land was in farms and the average size fell to 92.4 acres. Thereafter both the percentage of land in farms and the average size of farms increased to a maximum in 1910, when 51.3 percent of the land was in farms and the average size of a farm was 125.9 acres. Later there was a gradual decrease in both, there being only 44.4 percent of the land in farms in 1935 and the average size of a farm being 95.3 acres.

The percentages of farms operated by owners and tenants in 1880 were 64 and 36, respectively. These percentages were almost the same for 1935. In 1935, 38.7 percent of the tenants were croppers. A cropper operates under an agreement whereby the landlord furnishes the land, livestock, tools, feed, and one-half of the fertilizer and receives one-half of all crops produced. When the landlord rents to a share tenant, the owner usually furnishes the land and one-fourth of the fertilizer and receives one-fourth of the cotton and one-third of other crops. A cash tenant pays a stipulated cash rent for the farm and has all the crops produced. A fixed-commodity tenant has the same terms as a cash tenant, except that he pays the landowner a commodity rent, for instance, a stated quantity of cotton, instead of cash.

⁷ Percentages, respectively, of nitrogen, phosphoric acid, and potash.

Most of the farm laborers are native-born whites, and the supply is sufficient. On most farms the farmer, with members of his family, does the farm work, and when extra help is needed, as during threshing, exchange of help among neighbors is common. Monthly wages for farm hands range from \$10 to \$30 with board and washing. Day laborers are paid from \$1 to \$1.50.

The census reports \$15,093 paid for farm labor during the year 1929, an average of \$122.71 for each of the 123 farms reporting.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers or horizons called, collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil⁸ and its content of lime and salts are determined by simple tests. Drainage, both internal and external, and other external features, such as the relief, or lay of the land, are taken into consideration, and the interrelation of the soil and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into classification units. The three principal ones are (1) series, (2) type, and (3) phase. In places two or more of these principal units may be in such intimate or mixed pattern that they cannot be clearly shown separately on a map, but must be mapped as (4) a complex. Areas of land, such as coastal beach or bare rocky mountainsides that have no true soil, are called (5) miscellaneous land types.

The most important of these groups is the series, which includes soils having the same genetic horizons similar in their important characteristics and arrangement in the soil profile and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics, the same natural drainage conditions, and the same range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus Colbert, Fullerton, Jefferson, and Hartsells are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Hartsells fine

⁸ The reaction of the soil is its degree of acidity or alkalinity, expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

sandy loam and Hartsells very fine sandy loam are soil types within the Hartsells series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and, because of its specific character, it is usually the soil unit to which agronomic data are definitely related.

A phase of the soil type is recognized for the separation of soils within a type that differ in some minor soil characteristic having an important practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. For example, within the normal range of relief for a soil type, a part may be adapted to the use of machinery and the growth of cultivated crops and other parts may not. Even though no important differences are apparent in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, important differences may exist in respect to the growth of cultivated plants. Where such differences exist the more sloping parts of the soil type may be segregated on the map as a sloping or hilly phase. Similarly, soils having differences in stoniness may be mapped as phases, even though these differences are not reflected in the character of the soil or in growth of native plants. The symbols used to designate soil slope, as given in this report, have approximately the following definitions in terms of gradients:

- A.—0 to $2\frac{1}{2}$ percent, or level.
- B.— $2\frac{1}{2}$ to $7\frac{1}{2}$ percent, or undulating or gently sloping.
- C.— $7\frac{1}{2}$ to 15 percent, or rolling.
- D.—15 to 30 percent, or hilly.
- E.—30 percent+, or steep.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, complexes, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

SOILS

The soils of Dade County have developed in a humid region with a rainfall of slightly more than 51 inches and under moderate temperature. The soils supported a growth of mixed hardwoods and pines, and this cover was not conducive to the accumulation of a large quantity of organic matter in the soils. In the virgin forests a thin layer of partly decayed leaves and pine needles covered the surface, and the topmost 1 to 3 inches of the soil contained enough organic matter to give the soil a gray color. This organic matter originally present dissipated after a few years of cultivation of the soil.

This county has a varied relief. It comprises an irregular-shaped valley whose surface is gently sloping to rolling, with numerous sharp ridges. It is flanked on the east by Lookout Mountain, which rises to an elevation of about 1,100 feet above the valley floor, and on the west by Sand Mountain, which rises from 700 to 800 feet above the valley floor. All the soils of the uplands are naturally well drained, and in many places the surface is so steep that the run-off of rain water is rapid.

In the valleys silt loams are predominant, whereas on Lookout, Sand, and Fox Mountains the fine sandy loams and very fine sandy loams

predominate. These differences in the textures of the soils are, in a large measure, due to the textures of the rocks from which the soils have developed. The underlying rock formations differ widely. In the valleys these formations consist of fairly pure limestone or argillaceous limestone, cherty limestone, interbedded limestone and shale, and in small areas calcareous sandstone in the valley part of the county. On the tops of Lookout, Sand, and Fox Mountains they consist of deep beds of sandstone and conglomerate or interbedded sandstone and shale.

The upland soils of Dade County have developed from the weathered or disintegrated products of the rock formations through the soil-forming processes. There is a direct relationship as regards the chemical and physical characteristics between the soils and the underlying rock formations. The Colbert and the Talbott soils are developed from limestone or argillaceous limestone. They are characterized by light-gray or brown surface soils. Yellow heavy plastic clay or silty clay subsoils characterize members of the Colbert series, and reddish-brown silty clay subsoils characterize members of the Talbott series. Surface drainage is good, but internal drainage is very slow, owing to the impervious character of the subsoil.

The Fullerton and Clarksville soils are underlain by cherty limestone. Large quantities of angular cherty fragments occur on the surface and are more or less mixed throughout the surface soil and subsoil of the Clarksville soils. Here and there a few cherty fragments occur on the Fullerton soils. The Clarksville soils have light-gray or grayish-yellow surface soils and yellow silty clay loam subsoils. The Fullerton soils have grayish-brown or gray surface soils and light-red or reddish-yellow silty clay subsoils. Dewey-Waynesboro silt loams represent a soil condition rather than a definite soil type. The Dewey soil owes its origin to limestone or calcareous sandstone, whereas the Waynesboro soil has developed from sediments washed from soils underlain by sandstone and shale, together with an admixture of material from limestone. The Etowah and Sequatchie soils are developed on second bottoms or terraces. They consist of sediments washed from soils underlain, respectively, by limestone and by sandstone.

Associated with the upland soils in the valley and the soils developed on the terraces are small areas of colluvial soils. These are classed in the Allen and Jefferson series. They owe their origin to materials that have sloughed, washed, or rolled down from the materials on the higher mountains underlain largely by sandstone, together with some shale. They occur at the base of the mountains and spread out for a short distance on the valley floor. They are characterized by sandy surface soils and friable sandy clay subsoils.

The Hartsells and Hanceville soils are developed from sandstone and locally from interbedded sandstone and shale that cap Lookout, Sand, and Fox Mountains. The Hartsells soils have light-gray or grayish-yellow surface soils and yellow friable fine sandy clay subsoils. They are friable and mellow throughout. The Hanceville soils differ essentially from the Hartsells soils in that the subsoil is red friable fine sandy clay.

In the first bottom are long narrow strips of alluvial soils. These soils have developed from sediments washed mainly from soils underlain by sandstone and shale, together with an admixture of material from limestone. They are subject to overflow. In this group are

Pope, Philo, and Atkins soils which differ from each other mainly in color and drainage conditions. A few small areas of recent colluvial soils are classed as Abernathy silt loam and Colbert silt loam, colluvial phase. The materials giving rise to these soils have washed and sloughed down from areas of soils underlain by limestone or cherty limestone.

On the steep slopes of Lookout, Sand, and Fox Mountains are rather extensive areas of Muskingum stony fine sandy loam. This soil has a very thin or, in some places, no subsoil overlying the sandstone. Large areas of rough stony land (Muskingum and Hanceville soil materials) and smaller areas of rough stony land are underlain by limestone. In addition, small areas of mine dump are indicated on the soil map. Rock cliffs, consisting of narrow bands of rock outcrop, are indicated by symbol.

It has been estimated that between 50 and 60 percent of the total area of Dade County is so steep or so stony as to preclude its use for agricultural purposes other than forestry. In this large submarginal area are included Muskingum stony fine sandy loam, rough stony land (Muskingum and Hanceville soil materials), and rough stony land, together with some types of less importance.

The best agricultural lands occur in the smoother part of the valley and on the smoother parts of Lookout, Sand, and Fox Mountains. Approximately 80 percent of the land area never has been cleared and cultivated. About 50 percent of the land in Lookout Valley has been cleared and farmed, but of this probably 50 percent has been abandoned because of erosion or adverse economic conditions. About 12 to 15 percent of the land on Lookout, Sand, and Fox Mountains has been cleared. Some of the once-cultivated land is idle and is grown over with bushes, briars, and sedges. The alluvial soils in the first bottoms and on the terraces and the smoother uplands, free from stone, were the first lands to attract the early settlers. Their accessibility and ease of cultivation were important factors. At present, probably 90 percent of the population and farmers of the county are in the valleys. A direct relation exists between the population and the area of the land under cultivation in different parts of the county.

Some of the land in Lookout Valley and other valleys has been in cultivation for a century, whereas very little of the land on the mountains has been under cultivation more than 30 years. In many places, the soils in the valleys that always have been under rather continuous cultivation to clean-cultivated crops and have a slope ranging from 3 to 15 or more percent have lost through erosion much or all of the original surface soil and, in some places, part of the subsoil.

Wide differences in internal character, inherent fertility, relief, condition of erosion, drainage, and content of organic matter largely determine the productivity and ease of tillage of the soils. Soils, like the Hartsells and Hanceville, which are inherently low in the mineral plant nutrients, possess excellent physical characteristics. By virtue of these favorable physical conditions, these soils respond readily in yields to the application of commercial fertilizer or to green manuring, and they produce some of the highest yields of crops in the county. Colbert silt loam and Talbott silt loam are inherently stronger soils than those mentioned above, but their heavy, tough, impervious subsoils do not allow free percolation of rain

water. These differences in the soils have a marked influence on the agriculture.

In most instances a direct relationship exists between the crops grown or general agriculture of the county and the characteristics of the various soils. All the soils in Dade County have been grouped into classes and a miscellaneous classification of materials. The farming soils are included in two groups—Second-class soils and Third-class soils. No First-class soils occur comparable with those in other parts of the Tennessee Valley. Fourth-class soils (pasture land) and Fifth-class soils (forest land) comprise the remaining soils and land types, except the miscellaneous materials.

In the following pages, the soils are described in detail, and their agricultural relationships are discussed; their distribution and location are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 4.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Dade County, Ga.*

Type of soil	Acre	Per- cent	Type of soil	Acre	Per- cent
Fullerton silt loam	1,280	1.1	Fullerton silt loam, hill phase	1,920	1.7
Fullerton silt loam, slope phase	384	.3	Clarksville cherty silt loam, hill phase	5,696	5.1
Talbott silt loam	512	.5	Hanceville silt loam, hill phase	256	.2
Dewey-Waynesboro silt loams, eroded phases	448	.4	Armuchee silt loam, hill phase	3,840	3.4
Armuchee silt loam	768	.7	Armuchee silt loam, eroded phase	384	.3
Hartsells fine sandy loam	7,872	7.0	Rough tumbled land (Colbert and Armuchee soil materials)	64	.1
Hartsells very fine sandy loam	10,368	9.2	Atkins silt loam	256	.2
Etowah silt loam	1,344	1.2	Jefferson stony fine sandy loam	1,600	1.4
Etowah silt loam, eroded phase	512	.5	Hartsells fine sandy loam, slope phase	192	.2
Squatchie fine sandy loam	384	.3	Hartsells fine sandy loam, shallow phase	4,736	4.2
Allen loam	806	.8	Hartsells fine sandy loam, shallow slope phase	11,456	10.2
Colbert silt loam, colluvial phase	1,900	1.4	Hartsells very fine sandy loam, slope phase	320	.3
Abernathy silt loam	320	.3	Muskineum stony fine sandy loam	6,848	6.1
Pope silt loam	3,968	3.5	Smooth stony land (Hartsells soil material)	4,160	3.7
Colbert silt loam	2,240	2.0	Rough stony land (Muskineum and Hanceville soil materials)	19,072	16.9
Fullerton silt loam, eroded phase	128	.1	Rough stony land	5,376	4.8
Fullerton silt loam, eroded slope phase	2,304	2.0	Mine dump	256	.2
Clarksville cherty silt loam	640	.6			
Jefferson fine sandy loam	704	.6	Total	112,640	100.0
Etowah silt loam, eroded slope phase	512	.5			
Pope fine sandy loam	1,088	1.0			
Philo very fine sandy loam	1,024	.9			
Colbert silt loam, slope phase	1,600	1.4			
Colbert silt loam, hill phase	768	.7			
Colbert silt loam, shallow phase	1,600	1.4			
Rolline stony land (Colbert soil material)	2,944	2.6			

SECOND-CLASS SOILS (GOOD TO FAIR CROPLAND)

Second-class soils (good to fair cropland) include the best agricultural lands of the county, that is, those having a fair to good amount of durable organic matter; friable, mellow surface soils; and pervious, friable subsoils, the consistence and structure of which are generally favorable for absorbing and conserving moisture and for the penetration of plant roots. These soils are undulating or gently rolling and are well suited to the use of all kinds of farm machinery. They are free of stones and, with proper care, are not subjected to serious erosion. All are easy to cultivate, warm early in the spring, and crops on them respond quickly to the addition of barnyard manure, to the turning under of green-manure crops, and to commer-

cial fertilizers. Probably 95 percent of the land occupied by them is under cultivation.

In this group are Fullerton silt loam; Fullerton silt loam, slope phase; Talbott silt loam; Dewey-Waynesboro silt loams, eroded phases; Armuchee silt loam; Hartsells fine sandy loam; Hartsells very fine sandy loam; Etowah silt loam; Etowah silt loam, eroded phase; Sequatchie fine sandy loam; Allen loam; Colbert silt loam, colluvial phase; Abernathy silt loam; and Pope silt loam.

There are wide differences in the color, texture, and consistence of the soils in this group. The Fullerton soils differ from the others in that they are developed from cherty limestone and have light-red silty clay subsoils. Dewey-Waynesboro silt loams, eroded phases, are the reddest in this group and are developed from interstratified beds of limestone, calcareous sandstone, and shale. Talbott silt loam has a reddish-brown heavy tough to plastic clay subsoil over limestone. Armuchee silt loam differs from the Talbott soil mainly in that it is underlain by interbedded limestone and calcareous shale, and its subsoil, although about the same color, has a different consistence.

The Hartsells soils have developed from sandstone and conglomerate on the tops of the mountains; and the Sequatchie and Allen soils, which occur in the second bottoms and at the bases of the mountain slopes, respectively, have somewhat similar characteristics throughout. They comprise the lightest textured soils in the county and have friable fine sandy clay subsoils. Although their inherent fertility may be lower than that of some of the soils previously mentioned, their physical characteristics are such that they respond to fertilization and produce some of the best paying crops in the county.

Abernathy silt loam, Pope silt loam, and Philo very fine sandy loam have good physical characteristics and good moisture conditions. They are considered good agricultural soils but do not have so wide a crop adaptation as some of the soils of the uplands.

Fullerton silt loam.—In cultivated fields Fullerton silt loam is light grayish-brown friable pervious mellow silt loam to a depth of about 8 inches. Although the quantity of organic matter is small, it is stable. The surface layer is underlain to a depth ranging from 10 to 13 inches by yellow or light brownish-yellow highly leached friable silt loam. The true subsoil is reddish-yellow friable silty clay, which at a depth of about 34 inches rests on pale-red heavy but brittle silty clay that is splotched grayish yellow. At a depth ranging from 45 to 65 inches, the substratum consists of beds of broken chert interstratified with heavy red clay. Scattered over the surface are numerous angular fragments of chert ranging from a small fraction of an inch to 6 inches in diameter. In a few places chert fragments are present throughout the surface soil and subsoil.

Fullerton silt loam is associated with Clarksville cherty silt loam and Talbott silt loam and, as mapped, includes many small areas of these soils. It differs from the former soil in having a darker surface layer that contains more organic matter and plant nutrients, a heavier texture, a more red subsoil, fewer chert fragments throughout, and more favorable relief. It differs from the latter soil in its lower inherent fertility and in its more open, better aerated subsoil. As the contact with Talbott silt loam is approached, the subsoil is heavier and less permeable. The surface soil, owing to wash, is somewhat thinner on the steeper slopes of cultivated fields. At the bases

of slopes, however, where accumulation has taken place, the surface soil may range in thickness from 9 to 15 inches.

This soil occurs throughout Lookout Valley on the lower ridges and on the lower slopes of the higher ridges, which are underlain by beds of chert. The surface is undulating, its slope not exceeding $7\frac{1}{2}$ percent, and in most places it is less than 5 percent. Only a small total area is mapped.

The fine texture, together with a prevailing perviousness throughout, assures adequate drainage, good aeration, and rapid absorption of rain water, so that erosion is decidedly less active than on Talbott silt loam.

About 90 percent of the land is used for crop production, and 5 percent is in uncultivated fields, largely because of sheet erosion. The rest supports a second growth of oaks and pines. Of the cultivated land about 35 percent is devoted to corn, 25 percent to cotton, 10 percent to wheat, 23 percent to lespedeza, 5 percent to other hays, and 2 percent to fruits and vegetables. Yields are about as follows: Cotton from one-half to three-fourths of a bale per acre, corn 20 to 35 bushels, wheat 10 to 20 bushels, and hay 1 ton.

Commercial fertilizers are used profitably. Land for cotton commonly receives from 200 to 400 pounds per acre of a 4-10-4 mixture. Where corn follows cotton, the land usually receives no fertilizer at the time the corn is planted but is given a top dressing of 100 pounds of nitrate of soda when the plants are 18 to 24 inches tall. Wheat is sown on cornland in the fall. Wheatland in some instances is given a light application of fertilizer at sowing time and a top dressing of nitrate of soda in the spring. A small percentage of farmers grow crimson clover or hairy vetch as winter cover crops and plow them under before planting corn.

This soil is poorly supplied with organic matter. This deficiency can be overcome by growing legumes, such as crimson clover and hairy vetch in the winter, and lespedeza and cowpeas in the summer. Rye also has proved a beneficial winter cover crop. Where the land has been seriously depleted of its available plant nutrients, farmers have found that by turning under sorghum and peas, much better stands of other crops can be obtained. Decomposing plants furnish nitrogen, liberate other plant nutrients, and make the soil more absorptive of rain water and more retentive of moisture during dry periods. They also help in preventing erosion and greatly improve the physical condition of the soil for a good seedbed. Probably 95 percent of this soil requires terracing and contour cultivation to protect it from washing and gullying.

As a well-balanced farm program for Fullerton silt loam, Georgia State College recommends the following 3-year rotation: First year, cotton; second year, corn interplanted with a summer legume and preceded by a winter legume for the second year; and third year, small grain followed by cowpeas, soybeans, or lespedeza. A mixture of Bermuda grass, orchard grass, and lespedeza is considered good for pasture.

Fullerton silt loam, slope phase.—The slope phase of Fullerton silt loam has about the same distribution and is closely associated with the typical soil. It is unlike that soil in that the surface soil of light grayish-brown friable pervious silt loam averages about 6 inches thick, the slope averages about 11 percent, and sheet erosion

and gullying are more common, so that in many places only a few inches of the surface soil remain, and in some spots pale-red silty clay is exposed. As mapped, the soil includes numerous small areas of Fullerton silt loam; Fullerton silt loam, eroded phase; and Talbott silt loam. The aggregate area of Fullerton silt loam, slope phase, is small.

Perhaps 70 percent of the land is cultivated. Its productivity depends largely on the quantity of the original soil that remains. This soil is farmed in conjunction with the typical soil, but crop yields are slightly lower. Recommendations made for the improvement of Fullerton silt loam apply equally well for this soil; and in addition planting winter cover crops, strip cropping, terracing, and contour plowing to control erosion are recommended. Because of its slope more care must be exercised in handling this soil than in handling typical Fullerton silt loam, and somewhat more expense will be incurred.

Talbott silt loam.—Talbott silt loam resembles Fullerton silt loam in its relief and color of surface soil but is unlike it in its heavier texture throughout and underlying bedrock of limestone with a small quantity of interstratified calcareous shale. Its subsoil is not so heavy as that of Colbert silt loam; it is more red throughout, occurs in higher positions, and contains more organic matter and more available plant nutrients than that soil.

In cultivated fields the surface soil of Talbott silt loam consists of an 8-inch layer of grayish-brown or brown mellow rather heavy silt loam with some thoroughly incorporated organic matter. Underlying this is brownish-red heavy silty clay that breaks under pressure into small irregular-shaped blocks. At a depth of about 20 to 30 inches this material grades into mottled light-red and yellow plastic silty clay, which rests on limestone at a depth ranging from 30 to 72 inches.

On some steeper slopes and narrow ridges active erosion has removed all or part of the surface soil. In such areas the material in places is brownish-red silty clay, with some outcrops of limestone. At the bases of some slopes or in slight depressions where surface wash has accumulated, the surface soil is 10 or 12 inches thick. Included with this soil are small areas of Colbert silt loam and Fullerton silt loam.

Talbott silt loam occurs on low ridges southeast of Rising Fawn and in smaller areas in other parts of Lookout Valley. Its aggregate area is less than 1 square mile.

This gently rolling to sloping land does not exceed 15 percent and averages about 6 percent in gradient. Surface drainage is good, but internal drainage is only fair, as it is somewhat impeded by the heavy silty clay subsoil. This layer also inhibits percolation of rain water, causing a comparatively heavy run-off and, consequently, more serious sheet erosion than occurs on more absorptive soils, such as Fullerton silt loam and Clarksville cherty silt loam.

Approximately 80 percent of this soil is cultivated, of which it is estimated that 48 percent is in corn, 10 percent in cotton, 25 percent in lespedeza, 5 percent in other hays, 10 percent in wheat, and 2 percent in minor crops. Yields of corn range from 20 to 30 bushels an acre, cotton from two-fifths to three-fifths of a bale, hay 1 ton, and

wheat 10 to 18 bushels. Cornland and wheatland receive a light application of commercial fertilizer at planting time. Some of the farmers give corn a side dressing of nitrate of soda and wheat a top dressing of nitrate of soda in the spring. Land devoted to cotton is given an application of 200 to 400 pounds of a 4-8-4 mixture.

Talbott silt loam is a soil that can be built up to a fair state of productivity by growing and turning under leguminous crops.

Dewey-Waynesboro silt loams, eroded phases.—Dewey-Waynesboro silt loams, eroded phases, are a soil complex of several soil conditions rather than a definite uniform soil type. The designation includes areas of Dewey silt loam and Waynesboro silt loam, both of which have suffered more or less sheet erosion.

The areas of Dewey silt loam have a 6- to 8-inch surface soil of brown or reddish-brown mellow silt loam that contains a fair amount of organic matter. The subsoil is red or maroon friable pervious silt loam or silty clay loam containing a noticeable amount of fine sand. At a depth of about 30 inches this layer is splotched with yellow, and at a depth of about 40 inches it rests on the underlying formation of interstratified limestone and calcareous sandstone, with here and there a small amount of shale and also iron ore.

The areas of Waynesboro silt loam occur on old high terraces having a relief somewhat similar to the smoother uplands. The soil consists of sediments washed from soils underlain by sandstones and shales with a small admixture of materials from soil underlain by limestone. This soil and Dewey silt loam are acid in reaction.

Included with the Dewey-Waynesboro silt loams, eroded phases, is a small area to the west of Byrds Chapel and southeast of Rising Fawn that is more severely eroded than the soils of this complex, and in some places gullies have formed. Rock fragments are scattered over the surface in places. This severely eroded inclusion is less productive and more droughty than the soils designated elsewhere as Dewey-Waynesboro silt loams, eroded phases.

Where associated with Armuchee silt loam and Talbott silt loam, Dewey-Waynesboro silt loams, eroded phases, include small areas of those soils. Sheet erosion has removed the surface soil in many spots, exposing the dull-red silty clay loam or silty clay, particularly on steeper slopes. Along bases of slopes where the wash materials has accumulated, the thickness of the surface soil ranges from 10 to 15 inches. Bedrock outcrops here and there.

Dewey-Waynesboro silt loams, eroded phases, cover only a small total area, principally southeast of Rising Fawn. Slopes range from $2\frac{1}{2}$ to $7\frac{1}{2}$ percent. Surface and internal drainage are good. This soil, owing to its porousness, has good moisture-absorbing and holding capacities and can withstand excessive moisture and drought particularly well. Erosion, however, is noticeable on the steeper slopes where terraces have not been built and cover crops have not been grown.

It is estimated that about 95 percent of this soil complex is used in the production of cotton, corn, wheat, and hay. Of the cultivated land, about 40 percent is in cotton, 40 percent in corn, 10 percent in lespedeza and other hay crops, and 10 percent in wheat. Cotton yields from one-half to three-fifths of a bale an acre, corn 20 to 45 bushels, wheat 12 to 19 bushels, and hay 1 ton. Land for cotton is given an application of 200 to 400 pounds per acre of a 4-8-6 or

4-10-4 fertilizer, with a light application of 4-8-4 or 2-10-4 at time of sowing the grain that follows cotton, and a top dressing of nitrate of soda at the rate of about 75 to 100 pounds per acre in the spring. Cornland, when fertilized, receives an acre application of 200 to 300 pounds of 4-8-4 or 2-10-4 previous to planting and a side dressing of 75 to 100 pounds of nitrate of soda when the corn plants are from 18 to 24 inches tall.

Much of the land designated as Dewey-Waynesboro silt loams, eroded phases, requires efficient terracing, strip cropping, and the incorporation of organic matter. Growing lespedeza improves the soil, and this, together with growing winter and summer legumes and turning them under, is recommended for all areas of this soil.

Armuchee silt loam.—The 4- to 6-inch surface soil of Armuchee silt loam consists of brown or grayish-brown mellow friable silt loam containing a small quantity of organic matter. The upper part of the subsoil is reddish-brown friable silty clay loam. At a depth of about 15 inches this grades into reddish-brown brittle silty clay that breaks under ordinary moisture conditions into irregular-shaped lumps of various sizes. At a depth of 36 to 50 inches are beds of calcareous shale, interstratified shale and limestone, or limestone.

Included with Armuchee silt loam are small areas of a soil that differs from the typical soil in color and consistence of the subsoil. These variations are due to the underlying material from which the soil has developed. In some places the limestone and shale are interstratified, whereas in other places areas underlain by shale alternate within short distances with areas underlain by limestone. In the northeast corner of the county some of the soil is lighter colored, particularly on the more prominent ridges, than elsewhere, whereas southwest of Byrds Chapel the surface soil and subsoil are redder than elsewhere. Wherever the soil is underlain by shale, the color of both the surface soil and the subsoil is much lighter than it is in places where the soil is underlain by limestone.

The total area of Armuchee silt loam is small, and most of it is in Lookout Valley. The surface is gently sloping to gently rolling, the slope ranging from 2 to 15 percent with a dominant slope around 7 percent. In some places there are a few knobs and ridges. Surface drainage is good, but the rather dense character of the subsoil retards the movement of ground water. Rain water cannot penetrate the subsoil quickly, and, during heavy rainfall much of the water runs off the surface in places where the land is not properly terraced and where cover crops are not grown. As a result, sheet erosion causes considerable damage.

Probably 60 percent of this land is cultivated. Some of the land once cultivated is now grown over with old-field pines, briars, and bushes, and it affords scant pasturage. The rest was cleared of its original growth but now supports a growth largely of red oaks, together with some shortleaf and Virginia pines.

Corn, wheat, cotton, and hay are the principal crops. When fertilized, cornland receives light applications of 4-8-4 or 4-10-4 fertilizer and a side dressing of 75 or 100 pounds per acre of nitrate of soda. An application of 200 to 400 pounds of 4-8-4 or 300 pounds of 5-10-5 is usually made for cotton. When fertilized, wheatland receives from 200 to 300 pounds of 2-10-4 at sowing time and a top dressing of

nitrate of soda in the spring. Lespedeza responds readily to the addition of phosphatic fertilizer.

Hartsells fine sandy loam.—Hartsells fine sandy loam is light-gray or grayish-yellow mellow fine sandy loam to a depth of 6 or 8 inches. The upper part of the subsoil consists of pale-yellow heavy fine sandy loam that is only a few inches thick. It grades into yellow or slightly brownish yellow friable fine sandy clay, and, at a depth of about 25 to 30 inches there is yellowish-brown or brownish-yellow fine sandy clay or clay loam with here and there some splotches of gray. In most places the underlying sandstone or conglomerate lies from 33 to 40 inches below the surface. The upper 1- or 2-inch layer of these formations is friable and sandy. A few small rounded pieces of quartz gravel are scattered over the surface here and there. Both the surface soil and the subsoil are strongly acid in reaction. In wooded areas a thin layer of leafmold covers the surface and the upper 2- or 3-inch layer of soil contains enough organic matter to give the soil a dark-gray color.

Included with Hartsells fine sandy loam are small areas in which a part of the original surface soil has been removed through sheet erosion. In a few places the underlying sandstone lies near the surface or outcrops. At the base of some of the slopes the soil has accumulated to a depth of 8 to 15 inches, and generally this soil contains more organic matter than typical Hartsells fine sandy loam. On Sand Mountain about 3 miles southwest and about 2 miles northwest of Trenton and on Lookout Mountain southeast of Wildwood are small areas of Hanceville fine sandy loam. In these areas, the surface soil is brown or red fine sandy loam, and the subsoil is red friable fine sandy clay. If the areas were larger, this soil would be mapped as Hanceville fine sandy loam.

Hartsells fine sandy loam is the dominant soil south of Trenton on both Sand and Lookout Mountains, and it also occurs on Fox Mountain. Its total area is fairly large. It occurs on level to gently undulating interstream areas where the degree of slope ranges from 1 to 7 percent but averages about 4 percent. Its soil material came from the disintegration of beds composed largely of sandstone and conglomerate interstratified with thin beds of shale. Owing to the relief, the loamy surface soil, and friable subsoil, both surface and internal drainage are good. Although inclined to be droughty under careless farm practices, this soil absorbs and retains moisture fairly well if ample organic matter is incorporated in the surface soil. Some of this soil is sufficiently sloping to be subject to erosion in places where terracing, contour plowing, and growing cover crops are not practiced. Forested areas support largely a growth of red oak and shortleaf pine, with considerable blackjack, post, and chestnut oaks, as well as scrub pine (Virginia pine), mockernut (white) hickory, and black gum.

About 20 percent of this land is cultivated, and about 5 percent is in abandoned fields which are covered with a growth of sassafras, broomsedge, briars, old-field pine, and shrubs. The rest supports largely a growth of oaks and pines. The woodland is used as open-range pasture for cattle and hogs. About 50 percent of the cultivated land is used for corn; 5 percent for cotton; 14 percent for lespedeza; 6 percent for other hay crops; 5 percent for orchards; 10 percent for potatoes; 2 percent for sweetpotatoes; 1 percent for oats and rye; and 7 percent for turnips, cabbage, tomatoes, berries, string beans,

and other vegetables combined. Commonly, the average yield per acre of crops is as follows: Cotton about one-half of a bale, corn about 15 bushels, potatoes 100 bushels, sweetpotatoes 90 bushels, string beans 125 bushels, turnips 300 bushels, tomatoes 200 bushels, and hay three-fourths of a ton.

Because of its favorable texture and smooth surface, this soil is easily handled. It can be broken and cultivated under a wide range of moisture conditions. Plant roots and rain water readily penetrate the soil. It warms early in the spring and responds well to fertilization. Stable manure is especially beneficial. A winter cover crop, such as crimson clover, plowed under 15 days or so before planting corn, in conjunction with commercial fertilizer, increases yields considerably. Cotton land usually receives about 300 to 600 pounds an acre of a 2-10-2, 4-8-4, or 5-15-5 fertilizer. Where corn succeeds cotton, the land receives no additional fertilizer; otherwise from 100 to 200 pounds of superphosphate is applied. An acre application of 600 to 800 pounds of 4-8-6 fertilizer is made for potatoes and sweetpotatoes, about 400 pounds of 4-10-4 or 4-8-6 for cabbage, 300 pounds of 4-8-6 for string beans, 400 pounds of 4-12-4 for tomatoes, and 300 to 600 pounds of 4-8-6 for turnips.

One of the most important points in the management of Hartsells fine sandy loam is the increase and maintenance of actively decomposing organic matter. This soil constituent can best be supplied by growing leguminous crops, including crimson clover, hairy vetch, and Austrian Winter peas in the winter, and lespedeza and cowpeas in the summer. If the fertility of the soil is too low for growing the above-named legumes, growing and plowing under sorghum and peas as green-manure crops may be done before planting the legume.

The University of Georgia recommends a 2-year rotation for building up and maintaining the fertility of this soil type: Corn interplanted with cowpeas or soybeans and preceded with a winter legume for the first year, and truck crops succeeded by cowpeas or soybeans for the second.

On similar Hartsells fine sandy loam some 50 miles to the southwest on Sand Mountain on the Alabama Sand Mountain Substation experiment farm, a 6-year average for cotton and corn showed 1,611 pounds of seed cotton and 56.7 bushels of corn per acre. To obtain this, 600 pounds of a 0-10-4 fertilizer per acre was supplied to the land for hairy vetch or crimson clover. In the spring this was plowed under from 10 to 18 days before planting cotton. For this crop 600 pounds of a 6-8-4 fertilizer per acre was used. On another plot 400 pounds of a 0-10-4 fertilizer was used with hairy vetch, and this was succeeded by cotton with 200 pounds of the same kind of fertilizer. The average 6-year yield was 1,730 pounds of seed cotton per acre.

In many places fires have destroyed much of the young timber, seriously damaged matured timber, and impoverished the soil by burning off the grass and organic matter on the surface, so that on slopes steeper than 5 percent, sheet erosion and gullyng have developed.

Hartsells very fine sandy loam.—Hartsells very fine sandy loam differs essentially from Hartsells fine sandy loam in having a finer texture, a lighter colored surface soil and subsoil, and a slightly heavier textured subsoil, and in containing a smaller quantity of

organic matter. It also differs from the fine sandy loam in that it has developed from interstratified beds of fine-grained sandstone and shale.

It is closely associated in occurrence and origin with Hartsells fine sandy loam. It occurs almost entirely on Lookout and Sand Mountains in the northern part of the county.

This soil is developed on almost level, undulating, to gently rolling relief where the slope ranges from 2 to 7 percent with an average slope of about 4 percent. The surface is cut in numerous places by small intermittent streams or drainageways. The soil has good surface drainage and fair internal drainage, but the latter is not so good as that of Hartsells fine sandy loam, owing to the heavier character of the subsoil.

Hartsells very fine sandy loam, to a depth of 5 to 7 inches, is light-gray or grayish-yellow very fine sandy loam containing a high percentage of silt and having a low content of organic matter. It is underlain by a 4- to 6-inch layer of pale grayish-yellow or yellowish-gray leached friable fine sandy loam. The subsoil is grayish-yellow or pale-yellow hard but brittle heavy fine sandy loam or clay loam, grading into reddish-yellow hard brittle clay loam that is considerably spotted with light red, yellow, or yellowish red at a depth of about 34 to 36 inches. This rests on interstratified thin-bedded argillaceous sandstone and arenaceous shale from 34 to 40 inches below the surface. Both surface soil and subsoil are acid in reaction. In wooded areas a thin covering of leafmold is on the surface and the first 1 or 2 inches of the surface soil contain enough organic matter to give the material a dark-gray color.

Included with Hartsells very fine sandy loam are small areas of Hartsells fine sandy loam and a few small eroded areas where a large part of the surface soil has been removed. At the base of some of the slopes the soil from the higher lying areas has sloughed down and has accumulated to a depth of 12 to 15 inches. In some places where the surface soil is thick, bedrock lies 50 to 60 inches below the surface.

Only a small percentage of this land is under cultivation. The original vegetation was principally an oak and pine forest, in which red oak predominated. Most of the merchantable timber has been cut, and the greater part of the land now supports a growth of shortleaf pine; chestnut, post, and blackjack oaks; and a few mockernut (white) hickory, black gum, sweetgum, wild cherry, black walnut, pignut, tuliptree, white ash, sassafras, dogwood, and persimmon.

Corn is the principal crop, and the yields range from 12 to 25 bushels per acre, depending on whether some organic matter has been incorporated in the soil or commercial fertilizers have been used. Where fertilized, cornland receives from 100 to 200 pounds of 4-8-4 or 4-10-4 fertilizer. Yields of wheat range from 10 to 15 bushels per acre, and usually the land receives a light application of fertilizer. Only a small acreage is devoted to the production of cotton, and, where the land is fertilized, the yields average about one-half of a bale per acre. About the same fertilizer and cultural practices are used for potatoes on this soil as on Hartsells fine sandy loam. Garden vegetables and some fruits are grown.

For some years crops have been grown on Hartsells very fine sandy loam with little or no attempt to reestablish or maintain fertility.

The greatest need of this soil probably is incorporation of organic matter to increase its capacity for absorbing and maintaining moisture, thus enabling it to withstand better both excessively wet and dry periods. This practice also increases its ability to hold plant nutrients and, by filling interstitial spaces, decreases leaching, checks sheet erosion, and enables roots to make stronger development. It improves the consistence and, therefore, the workability of the soil, so that it will not clod seriously when dry or puddle when wet. Additional organic matter absorbs more of the sun's rays, thus warming the soil earlier in the spring and maintaining a more uniform temperature. In decomposing, weak organic acids form that liberate some of the unavailable elements, such as phosphorus and potassium, so that they will become nutrients for plants. Recommendations offered for the improvement of Hartsells fine sandy loam are equally applicable to this type of soil.

The effects of frequent forest fires are evidenced by the destruction of young timber, by injured mature timber, and by sheet- and gully-eroded surface soils. The last-mentioned injuries result because the fires burn the grass that holds the soil in place.

Etowah silt loam.—Under cultivation, Etowah silt loam consists of grayish-brown mellow silt loam to a depth of about 8 inches. Some organic matter is present and is well combined with the mineral particles. The material in this layer grades into brownish-yellow or yellowish-brown friable silt loam. At a depth of 12 or 14 inches this rests on yellowish-brown or reddish-brown friable silty clay loam, silt loam, or heavy very fine sandy loam. At a depth of about 40 inches is brown or yellow friable silty clay loam, silt loam, or fine sandy loam, with some splotches of gray and yellow.

In mapping this soil, many small areas of the eroded phase of Etowah fine sandy loam and Etowah loam are included. Also included are about 100 acres of soil on colluvial fans on lower slopes southwest and east of Hooker, and another area of colluvial and alluvial land along intermittent streams northwest of Byrds Chapel and west of Morganville where the content of organic matter is above normal. Another variation is where the texture throughout is heavier, and stratified beds of gravel and sand underlie the soil. This occurs in the vicinity of New England and Slygo Church and covers a total of about 1.1 square miles. Other inclusions, aggregating about three-fourths of a square mile, are on the remnants of high terraces near Rising Fawn and east and southeast of New England.

Etowah silt loam occurs on terraces along Lookout Creek in the vicinities of Rising Fawn and New England, and 1 mile southwest of Hooker along Pope Creek. Its aggregate acreage is small.

The land is almost level or slopes very gently toward the stream with a gradient ranging from 1 to 7 percent and averaging about 3 percent. This soil has developed from terrace materials transported from soils overlying limestone, sandstone, conglomerate, chert, and shale formations. Its porosity and friability, owing to its texture, promote excellent drainage throughout, as well as high water-absorbing and water-holding capacities, thus enabling it to withstand drought. Water permeates the heavy-textured variations, however, more slowly than it does the typical soil, although the internal drainage of these variations is fair.

Probably 95 percent of Etowah silt loam is under cultivation. Cotton and corn are the dominant crops. Some cowpeas, soybeans, peanuts, and wheat are grown. About 25 percent of the cultivated soil is used for cotton, 35 percent for corn, 10 percent for wheat, 23 percent for lespedeza, 6 percent for other hay, and 1 percent for vegetables. About 55 percent of the heavy-textured variations under cultivation is devoted to corn, 10 percent to cotton, 10 percent to wheat, 16 percent to lespedeza, 4 percent to other hay, 3 percent to blessed thistle, and 2 percent to soybeans, oats, and cowpeas. Cotton matures later than on the typical soil, and, therefore, it is grown less extensively under conditions of boll weevil infestation.

Yields on Etowah silt loam are from 20 to 50 bushels of corn an acre, 12 to 20 bushels of wheat, 1 ton of hay, and three-fifths of a bale of cotton. On the heavy-textured included soil, average yields of most crops are slightly higher, whereas yields of cotton are lower than on the typical soil. The lower cotton yield is due to the invasion of the boll weevil which is favored by late maturity.

Commercial fertilizers are profitably used. Land for cotton commonly receives from 300 to 600 pounds an acre of a 5 10-5 or 4 10-4 mixture. On cornland, 100 to 200 pounds an acre of superphosphate are applied.

Continuous cultivation without replenishing the organic matter has seriously depleted this valuable material. The deficiency can be overcome by growing winter legumes as soil builders and plowing them under from 10 to 15 days before planting corn in the spring. Crimson clover has proved especially efficacious for this purpose. In decomposing, the organic matter provides nitrogen, liberates other plant nutrients, increases the absorptive capacity, and makes the soil more retentive of moisture during dry periods. It also helps to prevent erosion and greatly enhances the physical condition for a good seedbed. On some of the colluvial land, erosion is noticeable. Properly constructed broad terraces, contour cultivation, deep plowing, and cover crops are recommended to control erosion.

Restoration and maintenance of the supply of organic matter and protection of the soil from leaching and washing by growing winter legumes are very important steps in the improvement of Etowah silt loam.

Etowah silt loam, eroded phase.—The eroded phase differs essentially from typical Etowah silt loam in that a large part or, in some places, all of the original surface soil has been lost through sheet erosion. The part that has not been washed away has been mixed with the material in the upper part of the subsoil, forming reddish-brown heavy silt loam or clay loam to a depth of 4 to 6 inches. The subsoil is reddish-brown firm but fairly friable and brittle clay loam or clay. This soil is underlain by rather heavy silty clay, particularly in an area to the northwest of Rising Fawn and also in an area about 2 miles northwest of New England.

Etowah silt loam, eroded phase, occurs in small areas on old terraces that have become dissected in many places. The slope ranges from about 2 to 7 percent. In many places the soil is so badly gullied that heavy farm machinery cannot be operated easily. Surface drainage is good to excessive, but internal drainage is slow.

Most of this soil has been cleared and is farmed. The rest supports a growth of briars, old-field pine, and brush. Cotton yields

about two-fifths of a bale per acre; corn, from 20 to 42 bushels; wheat, 10 to 19 bushels; and hay, mainly lespedeza, about 1 ton. Land devoted to cotton, corn, and, in some places, wheat, is given a light application of commercial fertilizer.

Etowah silt loam, eroded phase, is low in content of organic matter and possesses rather unfavorable physical conditions for plant growth. These conditions can be improved by growing winter and summer legumes and turning them under to increase the organic matter and also improve the physical condition of the soil. Kudzu and honeysuckle are recommended for controlling erosion on the badly gullied areas, and strip cropping in conjunction with broad terraces and contour cultivation are recommended for the more sloping areas.

Sequatchie fine sandy loam.—In cultivated fields, the surface layer of Sequatchie fine sandy loam is grayish-brown or brownish-yellow fine sandy loam containing a small quantity of organic matter, which is fairly well united with the mineral material. At a depth of 8 inches the material is yellowish-brown, brown, or reddish-brown fine sandy loam, which becomes heavier with increasing depth, resting on yellowish-brown or reddish-brown loam at a depth of about 15 inches. Below a depth of 30 inches is yellowish-brown or reddish-brown fine sandy loam, which is interstratified with thin beds of gravel and fine sand below a depth of 40 inches. Tests in the field indicate a medium degree of acidity.

As mapped, Sequatchie fine sandy loam includes numerous small areas of Etowah silt loam, loam, and loamy fine sand. On remnants of high terraces along Lookout Creek, east and southeast of New England and west of Rising Fawn, it includes about one-half of a square mile of a severely sheet-eroded variation. The surface configuration of this land is that of a thoroughly dissected high terrace with slopes ranging from 2 to 15 percent. The fine sand was transported mainly from soils underlain by materials that were derived from disintegrated sandstone; and the silt originates from residuum of shale and limestone. Drainage tends to be excessive, and the land is considered droughty. The surface soil is much thinner and lower in organic matter, and the lower part of the subsoil is heavier than are the corresponding layers of Sequatchie fine sandy loam.

Sequatchie fine sandy loam is typically developed in small areas on comparatively low terraces along Lookout Creek. It covers only a small aggregate area. The surface is level or gently sloping, with a gradient ranging from 2 to 6 percent. The soil material has been washed from soils underlain mainly by sandstone, together with some limestone, shale, chert, and conglomerate. Drainage is very good, owing to the texture and consistence of the surface soil and subsoil.

About 95 percent of this land is cultivated, of which approximately 45 percent is used for corn, 30 percent for cotton, 15 percent for hay, and 10 percent for garden vegetables, small grain, and other crops. Corn yields from 20 to 35 bushels an acre, wheat 10 to 20 bushels, cotton one-half to four-fifths of a bale, and hay $\frac{3}{4}$ to 1 ton.

Of the severely sheet-eroded variation occurring on high terraces, only about 50 percent is cultivated; 30 percent is in fields that are not tilled because of erosion and are overgrown with briars, smilax

vines, brush, and old-field pine; the rest, which was once cultivated, now supports a second growth of oaks and pines. Of the cultivated land, 35 percent is devoted to corn, 25 percent to cotton, 10 percent to wheat, 29 percent to hay, and 1 percent to vegetables.

On Sequatchie fine sandy loam and its eroded variation, the same quantities and kinds of fertilizer are used as on Fullerton silt loam. The land warms early and is well suited to the production of early vegetables, potatoes, and berries as well as cotton.

By growing legumes, such as those recommended for Fullerton silt loam, the much-needed organic matter can be incorporated and maintained. This added organic matter also would greatly increase the water-absorbing and water-holding capacities of the soil, insuring it against droughts. Proper terracing, strip cropping, and contour cultivating on the steeper slopes help to prevent erosion.

Allen loam.—The surface soil of Allen loam to a depth of 6 to 10 inches is brown mellow loam containing a small quantity of organic matter. The subsoil is dull-red or reddish-brown friable loam, which grades at a varying depth into hard very brittle and friable silty clay loam or friable clay. This material is underlain at a depth of 40 to 50 inches by gravelly loam that is reddish yellow, splotched with red and yellow. Scattered over the surface and throughout the surface soil and subsoil in some places are rounded or smoothly angular sandstone cobbles and boulders ranging from 2 to 30 or more inches in diameter. These do not occur in sufficient quantities to interfere seriously with cultivation.

Included with Allen loam are small areas of Allen fine sandy loam and Jefferson fine sandy loam. West of Hooker is a small area in which the surface soil is severely sheet eroded. This soil occurs on old high terraces and differs from typical Allen loam in having a gray surface soil, a gray or yellow subsoil, and underlying material consisting of beds of gravel and sand.

Allen loam occurs on old alluvial or colluvial fans at the base of Lookout Mountain, in Wills Valley southeast of Rising Fawn and in Lookout Valley east of Trenton, and also at the base of Sand Mountain southwest of Hooker. Small bodies are mapped with Jefferson stony fine sandy loam in Murphy and Egypt Hollows. The soil has developed from materials underlain by sandstone and conglomerate and to less extent from shale and limestone that have sloughed, rolled, or washed down from the steep mountainsides when the mountains were probably at a higher elevation than they are today.

This land ranges from almost level or undulating to gently sloping. In most places it slopes gradually from the mountainsides and has a gradient ranging from 2 to 7 percent. Both surface and internal drainage are good. The loam texture, together with the friable and pervious character of the subsoil, enables the soil to take up a large quantity of the rain water and hold it for the use of plants.

About 90 percent of this soil is under cultivation. The rest is grown over with broomsedge, brush, and old-field pine. Allen loam is considered one of the good agricultural soils of the county because of its inherent fertility and because of its good physical characteristics. It is easy to cultivate and responds readily to applications of commercial fertilizers and to the turning under of green-manure

crops. Like the other soils of the county, it is deficient in organic matter; but this material can be supplied easily.

Cotton yields from one-half to four-fifths of a bale per acre depending on the season and the quantity of fertilizer applied. Land devoted to cotton usually receives from 200 to 600 pounds of 4-10-4 or 4-8-6 fertilizer per acre. Corn yields from 20 to 40 bushels per acre, and the land ordinarily is given a light application of fertilizer unless corn follows a leguminous crop that has been turned under. Some of the farmers give the corn a side dressing of nitrate of soda when the plants are from 18 to 24 inches tall. Wheat yields from 12 to 18 bushels per acre, and the land is usually fertilized with 200 to 300 pounds of 4-10-4 or 2-10-2 fertilizer at the time of sowing and sometimes is given a top dressing of nitrate of soda in the spring. Lespedeza does well on this soil, but its growth is greatly increased by an application of phosphatic fertilizer.

Colbert silt loam, colluvial phase.—Colbert silt loam, colluvial phase, contains some fine sand grains and gravel throughout. This gives it a friability and perviousness that are not common to Colbert silt loam.

In cultivated fields the surface soil consists of light brownish-gray or grayish brown friable silt loam that contains some fine and very fine sand and has a fair content of stable organic matter. Below a depth of 8 or 10 inches the texture is silty clay loam, and it becomes heavier with increasing depth until the material grades, at a depth of about 20 inches, into brownish-yellow heavy yet somewhat friable silty clay. This clay carries numerous ferruginous or manganese concretions and continues downward to a depth of more than 40 inches. In many places strata of gravel, gravelly sandy loam, and coarse or medium sand underlie the subsoil at a varying depth. Determinations in the field indicate medium acidity for this soil.

Colbert silt loam, colluvial phase, occurs throughout Lookout Valley on alluvial fans along small intermittent streams and in depressions. Its aggregate area is small. The land is very gently sloping, having a gradient of 1 to 3 percent. The parent material of this soil is colluvium, transported largely from Colbert silt loam and, to less degree, from Hartsells fine sandy loam and Hartsells very fine sandy loam. Because of some friability and openness throughout this soil, surface and internal drainage, as well as the water-absorbing and water-holding capacities, are fair to good—much better than those characteristics of typical Colbert silt loam.

Almost all of this soil is in cultivation. About 50 percent is devoted to corn, 20 percent to lespedeza, 5 percent to other hay crops, 15 percent to wheat, 5 percent to cotton, and 5 percent to orchards, truck crops, and small grains.

The methods of management and fertilization common throughout Lookout Valley are practiced on this land. Cotton yields one-half to three-fifths of a bale an acre, corn 18 to 40 bushels, wheat 10 to 18 bushels, and hay 1 to 2 tons; in fact all crops yield about 10 percent higher than on Colbert silt loam because of better drainage, more favorable texture, better consistence throughout, and superior workability.

For the improvement of this land, the University of Georgia advises the following rotation: First year, a winter legume followed by corn interplanted with a summer legume; second year, small grain

succeeded by lespedeza, cowpeas, or soybeans; and third year, grass and legumes for grazing. Pasture can be established by sowing Dallis grass, timothy, lespedeza, white clover, and alsike clover.

Abernathy silt loam.—The surface soil of Abernathy silt loam is brown mellow friable silt loam with a tinge of red in many places and an invariably high content of stable organic matter. This layer grades at a depth of about 24 inches into brown friable silt loam with a gray tinge and splotches of brownish gray. Below a depth of 40 inches the material is grayish-brown silt loam with some gray, brownish-gray, and yellowish-gray mottlings. Colorimetric determinations show medium acidity throughout to a depth of 40 inches.

As mapped, Abernathy silt loam includes about 20 acres of soil 1 mile west of Trenton in a valley depression where the soil material is much grayer than typical.

Abernathy silt loam occurs in small depressions throughout Lookout Valley. The aggregate area is small. Its surface is almost level or very gently sloping. Colluvial sediments washed or sloughed down from soils underlain by limestone, chert, and calcareous shale make up the parent materials. The silt loam texture, together with the perviousness of this material, assures good moisture-absorbing capacity, good moisture-holding capacity, and good surface and internal drainage where ditches for the run-off of surplus water are provided.

All this land is cultivated. Probably 70 percent is used for corn, 5 percent for wheat, 20 percent for lespedeza, and 5 percent for other hay crops.

Owing to its high content of organic matter, inherent fertility, and favorable texture, consistence, and structure, this is one of the best soils for the production of corn, which yields 40 to 50 bushels an acre. Hay yields about 1¼ tons an acre.

Pope silt loam.—Brown well-drained level uniform areas of silt loam in the flood plains of Lookout Creek and its tributaries constitute Pope silt loam. This soil and Abernathy silt loam represent the most fertile and productive soils for corn in the county. The total area of Pope silt loam is small.

Pope silt loam is grayish-brown or brown friable mellow silt loam, which grades very gradually to a somewhat lighter colored slightly heavier textured material at a depth of 10 or 12 inches. This continues downward to a depth of 3 to 4 feet, where it is underlain by yellowish-brown heavy silt loam or light-textured silty clay loam. The soil is characterized by a slightly acid reaction throughout, as shown by colorimetric determinations to a depth of 40 inches, by the presence of organic matter, and by a comparatively high state of inherent fertility. This soil is more or less dotted with small areas of less desirable texture, such as fine sandy loam, loamy fine sand, and fine sand. These inclusions are less productive and less drought-resistant than the silt loam. The materials represent recent flood-plain depositions. The heavier textured inclusions, such as silt loam and silty clay loam, represent materials transported from Lookout Valley, largely from limestone and shale residuals, together with a small admixture of ferruginous sandstone. On the other hand, the coarser textured materials come principally from the soils underlain by sandstone and conglomerate materials on Lookout, Sand, and Fox Mountains. The friable and pervious character throughout assures good drainage. For the most part, the soil has high water-absorbing and water-holding

capacities, but the loamy fine sand and fine sand inclusions are low in both these qualities.

Combined with Pope silt loam are very small areas along intermittent streams in the northeast corner of the county, southeast and northeast of Byrds Chapel, and 1 mile northeast of New England. These consist of colluvial silty clay loam washed from Armuchee silt loam. This included soil differs from typical Pope silt loam in its redder color and heavier texture throughout.

Practically all of Pope silt loam is under cultivation. About 75 percent of the land is used for the production of corn, 15 percent for hay, 9 percent for wheat, and 1 percent for oats. Yields of corn range from 30 to 50 bushels an acre, the higher yields being obtained with a small application of fertilizer. Wheat yields from 10 to 20 bushels an acre and hay about 1½ tons.

Because of its high content of organic matter and plant nutrients and because of excellent moisture conditions, Pope silt loam is particularly suited to the production of corn and hay. The highest yields of these crops in the county are obtained on this soil. Wheat grows so tall that it is often severely injured by lodging.

THIRD-CLASS SOILS (FAIR TO POOR CROPLAND)

Third-class soils include Colbert silt loam; Etowah silt loam, eroded slope phase; Fullerton silt loam, eroded phase; Fullerton silt loam, eroded slope phase; Clarksville cherty silt loam; Jefferson fine sandy loam; Pope fine sandy loam; and Philo very fine sandy loam.

The soils in this group possess some unfavorable qualities, and these negative qualities are more prominent in the soils of this class than in the Second-class soils. In Third-class cropland the surface soils are badly eroded or gullied in places; the underlying rock formation is near the surface in some places and even outcrops here and there; some of the soils are leachy, droughty, and very low in both mineral and organic nutrients; and some of them have impervious heavy clay subsoils. In places the surface is steep, and there is enough stone to interfere with cultivation. Most of these soils are farmed to more or less extent, but they cannot be managed so economically as the soils of the Second class. They require more terracing and strip cropping in order to lessen the effects of sheet erosion. In the eroded phases, erosion has removed much of the original surface soil, reduced the organic content of the soil, and made cultivation slightly more difficult. By proper management, however, the productivity of these soils can largely be restored by growing and turning under leguminous crops.

Colbert silt loam.—Under cultivation, the 6- or 8-inch surface layer of Colbert silt loam is light brownish-gray heavy silt loam containing a small quantity of stable organic matter. Underlying this is a thin layer of grayish-yellow silty clay, which rests on yellow heavy impervious silty clay with gray mottlings. At a depth of about 30 inches, this grades into mottled yellow and gray heavy impervious silty clay. Limestone, with thin layers of interstratified calcareous shale, generally lies from 38 to 48 inches below the surface, although it is less than 18 inches below the surface in a few places. Here and there sheet erosion has removed the surface soil and ex-

posed the impervious silty clay. Limestone outcrops in some places. Along the bases of slopes where materials from the higher areas have accumulated, the surface soil is as much as 10 to 15 inches thick.

Small areas, aggregating about 1 square mile, have a subsoil, at a depth of 12 inches, of reddish-yellow or mottled-yellow impervious clay, which, at a depth of about 36 inches, rests on impervious olive-green silty clay. This variation occurs chiefly in the vicinity of Cloverdale. Field determinations indicate medium acidity in the surface soil, a strongly acid subsoil, and an alkaline substratum.

This soil is well distributed in small areas throughout Lookout Valley, but it occurs largely in the vicinities of Trenton and Sulphur Springs. The total area is small. Surface features are smooth undulations and long gentle slopes on low ridges with an average gradient of about 4 percent, so that the soil lies favorably for agricultural operations.

Surface drainage is good, but the impervious subsoil impedes the movement of ground water. In old cultivated fields the soil warms slowly in the spring and remains waterlogged long after heavy rains. In the woods or in newly cleared fields, where tree roots are in all stages of decomposition, internal drainage, although poor, is decidedly better than in old cultivated fields, where old root courses have been closed by the soil material running together. Except where the surface soil is several inches thick, the absorbing capacity is low, as rain water cannot percolate quickly into the impervious subsoil and so is compelled to run off over the surface, greatly damaging uncovered and unprotected soil by sheet and gully erosion.

About 70 percent of this soil is under cultivation, and 15 percent is in uncultivated fields grown over with old-field pine, briars, and bushes. The rest is forested with a mixed growth of oak and pine. Of the cultivated land, about 50 percent is used for corn, 20 percent for wheat, 25 percent for lespedeza, and 5 percent for other hays.

The principal type of agriculture practiced on this soil consists of growing corn, hay, and wheat in conjunction with raising a few dairy and beef cattle and hogs. Corn yields about 15 to 25 bushels an acre, wheat 10 to 14 bushels, and hay $\frac{3}{4}$ to 1 ton. Where fertilized, cornland is given an application of 200 to 300 pounds of 4-8-4 fertilizer. Until the organic matter content of this soil is increased, it probably would be better to use a 6-8-4 mixture. Wheatland is given an application of 200 pounds of 2-10-2 or 4-10-4 and a top dressing of nitrate of soda in the spring. Lespedeza and other legumes benefit by adding commercial fertilizers and lime to the land.

This land needs a system of farming that will maintain and increase its supply of organic matter and include a deep rooted crop capable of permeating its plastic subsoil. It is known that winter legumes, particularly crimson clover, and summer legumes, such as lespedeza or cowpeas, effectively supply organic matter. It is probable that the application of 2 to 3 tons of ground limestone would make it possible to produce sweetclover. This plant sends its heavy roots downward to the bedrock, and these roots on decomposing leave channels through which water and air could readily drain. Good stands of sweetclover plowed under for corn and followed by wheat provide much-needed organic matter and improve internal drainage.

The University of Georgia considers this land best suited for pasture. It is suggested that pasture be established by first treating

it with phosphorus and lime, after which a mixture of Bermuda grass, Dallis grass, timothy, lespedeza, white clover, and alsike clover should be sown. Crimson clover can be added in the fall.

Fullerton silt loam, eroded phase.—Fullerton silt loam, eroded phase, differs from typical Fullerton silt loam in that erosion has removed part or all of the original surface soil. It occurs on practically the same relief as Fullerton silt loam; that is, on slopes of about 2 to 7 percent. The total area is very small.

All this land has been cleared and farmed, but the most severely eroded areas support a growth of sedges, briers, and bushes. Yields are considerably lower than those obtained on typical Fullerton silt loam. These eroded areas can be improved by constructing broad terraces, by deeper plowing, by strip cropping, and by adding organic matter.

Fullerton silt loam, eroded slope phase.—Fullerton silt loam, eroded slope phase, differs principally from typical Fullerton silt loam in that a large part or all of the original surface soil has been removed by sheet erosion. It differs from the eroded phase in having a steeper slope—from 8 to 15 percent. Surface drainage is good to excessive, and internal drainage is fair.

The surface soil consists of brown silt loam or pale-gray loam, from 3 to 6 inches thick. It contains but a small quantity of organic matter. The subsoil is reddish-yellow stiff brittle silty clay. This grades at a varying depth into broken angular chert fragments and light-red silty clay.

The larger areas of Fullerton silt loam, eroded slope phase, occupy slopes along the bases of Sand Mountain and the high chert ridges of Lookout Valley. Smaller areas occur throughout Wills and Lookout Valleys, particularly along the base of Lookout Mountain. The total area covered by this soil is not large.

Owing to the friable pervious surface soil and friable silty clay subsoil, surface drainage and internal drainage, as well as the natural moisture-absorbing and moisture-holding capacities, are good.

Almost all of this land has been cleared; but at present only about 40 percent of it is under cultivation and 30 percent is in uncultivated fields, where erosion following clean cultivation has carried away part of the surface soil. Such fields are covered with a growth of sedges, briers, old-field pines, and bushes. The remaining 30 percent is covered with a second-growth forest, principally of oak and pine.

The crops grown, fertilizer treatment, and farm practices are about the same as for Fullerton silt loam. Crop yields, however, are 15 percent lower than on that soil, largely because of the removal of part of the original surface soil through sheet erosion. Suggestions for the improvement of Fullerton silt loam are applicable for this soil.

Clarksville cherty silt loam.—Clarksville cherty silt loam is light-gray or grayish-yellow silt loam to a depth of about 6 inches. It contains only a small quantity of organic matter. The subsoil is grayish-yellow or pale-yellow friable cherty silty loam, which grades at a depth of about 20 inches into yellow or reddish-yellow cherty silty clay. Angular chert fragments interstratified with beds of yellow heavy cherty clay lie at varying depths and in places extend to a depth of several feet. In some places, this layer becomes light red—the color of the material that underlies Fullerton silt loam. Angular

chert fragments ranging from $\frac{1}{4}$ to 5 inches in diameter are present on the surface, in the surface soil, and, in places, in the subsoil.

Clarksville cherty silt loam occurs on the lower slopes of the steep ridges. It is one of the less extensive soil types. The largest area is in the vicinity of Sulphur Springs; a few smaller ones are scattered throughout Wills and Lookout Valleys. The surface is smooth with slopes ranging from 2 to 15 percent and averaging about 8 percent. Surface drainage is excellent, and internal drainage is good. This soil has the ability to absorb considerable quantities of rain water and is less susceptible to erosion than some of the other soils that have heavier subsoils and similar relief. Sheet erosion and gullies once started on this soil make heavy inroads in a short time, so that terracing and the growing of cover crops are essential for maintenance.

About 60 percent of Clarksville cherty silt loam is under cultivation. The rest is either in second-growth forest or was once cultivated and has grown over with old-field pines, broomsedge, and bushes.

About 50 percent of the cultivated land is in corn, and the yields range from 15 to 25 bushels an acre, depending on the amount of organic matter in the soil and the quantity of fertilizer applied. Cotton yields from one-half to three-fifths of a bale, and the land usually receives an application of 200 to 400 pounds of a 4-10-4 or 2-10-2 fertilizer. Wheat yields from about 8 to 12 bushels. Lespedeza does well, and from 1 to $1\frac{1}{2}$ tons of hay per acre have been obtained, especially where the land has been given an application of phosphatic fertilizer. This soil can be greatly improved by growing and turning under leguminous crops to supply the needed organic matter. The soil responds to good treatment and to the addition of commercial fertilizers and manures.

Jefferson fine sandy loam.—The cultivated soil of Jefferson fine sandy loam to a depth of 6 to 8 inches is brownish-gray or gray mellow fine sandy loam containing a small quantity of rather loose organic matter, which is not well combined with the mineral soil. Underlying this is pale-yellow or grayish-yellow loam, which, at a depth of about 12 to 14 inches, grades into yellow or reddish-yellow friable fine sandy clay. At a depth of about 40 inches, this material passes into pale reddish-yellow loam with red and yellow splotches. Scattered over the surface and through the surface soil and subsoil in a few places are rounded sandstone cobbles and boulders ranging in diameter from a few inches to 3 feet. In some places they interfere with cultivation. Stony areas large enough to map are included with Jefferson stony fine sandy loam.

A few small areas of Jefferson loam and Sequatchie fine sandy loam are included with this soil in mapping. It also includes an aggregate area of about one-third of a square mile of sheet-eroded bodies of Allen loam. Some of these are between Rising Fawn and Sulphur Springs. In these areas the surface soil is almost all gone and the surface slopes average about 10 percent. As the crop adaptations of this inclusion are restricted, it is described with Jefferson fine sandy loam rather than with Allen loam, which is placed in the Second class.

Jefferson fine sandy loam occurs east of Rising Fawn, east of Trenton, and in Murphy Hollow. Smaller areas occur east of Hooker, along Pope Creek, and in Cole City Hollow. Its total area

is small. The relief ranges from undulating to gently rolling, with a gradient of 2 to 7 percent. Natural surface drainage and internal drainage are good. Like Allen loam and Jefferson stony fine sandy loam, this soil has developed from materials underlain by sandstone and conglomerate, which have sloughed or washed down from the upper mountainsides. In some places there is an admixture of materials underlain by shale and limestone, washed particularly from the lower slopes of Lookout Mountain.

A considerable percentage of Jefferson fine sandy loam is under cultivation. The rest supports a second growth of various oaks and old-field pine. Corn and cotton are the principal crops, and a small acreage is devoted to the growing of hay and wheat. Yields of cotton average about two-fifths of a bale, corn 15 to 32 bushels, and wheat 8 to 15 bushels. A small quantity of commercial fertilizer per acre is applied for cotton, but ordinarily no fertilization is given for corn. Lespedeza does well on this soil.

Jefferson fine sandy loam has good physical characteristics. The soil warms early in the spring and responds readily to the addition of commercial fertilizer and to the incorporation of organic matter. The few stony areas of this soil should remain in forest, as the cost of gathering and removing the stones from the surface is not warranted under present economic conditions.

Where cultivated, this land is very much in need of more organic matter to improve the tilth and increase its fertility, as well as its moisture-absorbing and moisture-holding capacities. The organic matter can best be incorporated in the soil by a winter cover of legumes that are plowed under for corn, as well as by lespedeza and cowpeas grown in the summer. Suggestions for increasing organic matter in Fullerton silt loam apply also to this land.

Etowah silt loam, eroded slope phase.—Etowah silt loam, eroded slope phase, is developed in close association with the eroded phase of this soil, north and south of Rising Fawn, on slopes ranging from $7\frac{1}{2}$ to 15 percent and averaging about 11 percent. This soil covers a small total area. It differs from the eroded phase in that it has steeper slopes, more and deeper gullies, and almost all of the original surface soil has washed away.

About 30 percent of the land is in small, intergully patches; 65 percent has been abandoned because of gullying; and 5 percent is covered with second-growth trees, mainly oaks and pines. The cultivated land is farmed in conjunction with Etowah silt loam, eroded phase, but the yields are considerably lower.

Reclamation of this land may be accomplished by a system of management like that recommended for Etowah silt loam, eroded phase.

Pope fine sandy loam.—In cultivated fields, the surface soil of Pope fine sandy loam is brown mellow fine sandy loam containing a small quantity of organic matter. Beginning at a depth of 8 to 12 inches and continuing to a depth of 40 or more inches, the subsoil is yellowish-brown or brownish-yellow fine sandy loam. In some places the subsoil is reddish-brown fine sandy loam or loam. The surface soil and subsoil are acid in reaction.

Combined with this soil in mapping are small areas of Pope loamy fine sand, fine sand, loam, and silt loam, as well as Philo fine sandy

loam and loam. The Philo soils are more gray throughout and are more poorly drained than the Pope soils. In Murphy Hollow, an aggregate of about 80 acres of Pope fine sandy loam is lower than average in organic matter and other plant nutrients. The same crops are grown as elsewhere on Pope fine sandy loam, but yields are about 5 percent lower. Also included with Pope fine sandy loam are about 50 acres of Pope loamy fine sand in the flood plain of Lookout Creek about 1 mile northeast of Trenton. This soil differs principally in its lighter texture. Still other inclusions are small areas consisting of gravelly material and cobblestones to a depth of about 3 feet, on the flood plains of Lookout Creek. These aggregate about 15 acres east of Trenton and northeast of Cloverdale.

Pope fine sandy loam is well distributed along Lookout Creek and its larger tributaries in all parts of Lookout Valley, although its aggregate extent is small. The surface is almost level with slopes not exceeding 2 percent and averaging less than 1 percent. Because of its light texture, porous character, and low content of organic matter, the soil tends to be droughty for a first-bottom soil.

All this land is cultivated, except perhaps about 10 percent of it which adjoins streams and is subject to very frequent overflow. Such land supports a scattered growth of sycamore, willow, red maple, gum, and alder.

About the same crops are grown as on Pope silt loam, but 20 percent lower yields are obtained than on that soil. This is due largely to the porosity of Pope fine sandy loam, low content of organic matter, and lower content of mineral plant nutrients.

Although Pope fine sandy loam is subject to rather frequent overflow, it is a well-drained first-bottom soil. The soil is easy to till, responds readily to fertilizer, and, like most of the soils in Dade County, is deficient in organic matter. When supplied with organic matter, this soil will produce fair yields of corn, and, when fertilized, garden vegetables and truck crops can be grown successfully.

Philo very fine sandy loam.—Philo very fine sandy loam is grayish-brown very fine sandy loam to a depth ranging from 15 to 20 inches. It contains a noticeable quantity of finely divided organic matter. The subsoil is grayish-yellow or light-gray, mottled with yellow and brown, silty clay loam. The mottlings are more pronounced in the lower part of the subsoil. At a depth ranging from 40 to 50 inches the material is grayish-yellow silty clay loam with gray and yellow mottlings, and this is underlain at a varying depth by mottled fine sandy and gravelly material. In some places the upper part of the subsoil is brownish-gray heavy silt loam or very fine sandy loam.

In the first bottoms along the streams on Lookout and Sand Mountains the surface soil is brownish-gray very fine sandy loam underlain at a depth of 8 to 10 inches by grayish-yellow heavy silt loam. In some poorly drained depressions are a few small areas of soil material washed from the Colbert soils of the upland. Some of the small areas along the intermittent streams on Lookout Mountain and 3 miles northwest of Trenton on Sand Mountain are silty. Another variation included with this soil occurs in small areas along the tributaries of Lookout Creek in the northeast corner of the county. In this locality the surface soil is grayish-brown mellow silty loam underlain at a depth of 12 to 15 inches by brownish-gray silt loam

containing brown and gray splotches, which grades into heavy compact silt loam. Another inclusion is a small area of Colbert silt loam, colluvial phase, lying 1 mile east of Trenton and near the base of Lookout Mountain. The soil in this particular area is neutral in reaction, and its content of organic matter is higher than that of typical Philo very fine sandy loam.

Philo very fine sandy loam occurs in the first bottoms along the streams and intermittent drainageways. It is intermediate in drainage between the well-drained Pope soils and the poorly drained Atkins soils. The surface is almost flat, with a very gradual slope that does not exceed 2 percent. The largest areas of Philo very fine sandy loam are acid in both surface soil and subsoil. Most of the land requires artificial drainage to reclaim it for the production of corn and other crops, except hay. The moisture condition of this soil in moderately dry seasons are very favorable, but during wet seasons crops are likely to suffer from an excess of moisture.

About 10 percent of Philo very fine sandy loam is under cultivation; some of it is in pasture or used for hay, and the remainder is in forest. The forest growth consists of a variety of oaks, a few shortleaf pine, sweetgum, walnut, red maple, alder, sycamore, beech, willow, and other trees common to this locality.

Corn is the principal crop, and yields range from 25 to 40 bushels per acre. Hay is the next crop of importance, and 1 or more tons per acre are obtained. Usually no fertilizer is applied for these crops, but where the soil is used for garden vegetables and truck crops, a heavy application of a 4-10-4 or 4-8-6 mixture is applied. In its natural condition Philo very fine sandy loam is well suited for pasture grasses, which is the best use for it. When artificially drained and, in some instances, limed, however, this soil can be used successfully for growing corn.

FOURTH-CLASS SOILS (PASTURE LAND)

Fourth-class soils comprise Colbert silt loam, slope phase; Colbert silt loam, hill phase; Colbert silt loam, shallow phase; rolling stony land (Colbert soil material); Fullerton silt loam, hill phase; Clarksville cherty silt loam, hill phase; Hanceville silt loam, hill phase; Armuchee silt loam, hill phase; Armuchee silt loam, eroded phase; rough gullied land (Colbert and Armuchee soil materials); and Atkins silt loam.

A small percentage of this land is now under cultivation. At one time much of it was cleared and afterward abandoned. It now supports a small growth of mixed hardwoods and pine. At present the best use for the soils in this group is for pasture. It is true that small areas of some of these soils, owing to their steepness of slope, stony character, and droughty condition, are not well suited even to the growth of pasture grasses. It is very difficult, however, to delineate each area on the map according to its proper land use. Certain economic conditions may make it profitable to cultivate part of these lands. In placing the soils in this group, the characteristics of the soils, as regards their texture, structure, consistence, and depth over bedrock, are given due weight. In addition, the condition of erosion, the steepness of slope, stoniness, and drainage are considered. Ease of tillage, moisture-absorbing and moisture-holding capacities, other inherent qualities, and cost of farming operations actually place

these soils in this group rather than in the group of agricultural soils.

Colbert silt loam, slope phase.—This soil has a small aggregate area. It is associated with Colbert silt loam, from which it differs essentially in its steeper slope—from 7 to 15 percent. It also differs from the typical soil in that the surface soil and subsoil are thinner over bedrock, the organic-matter content is slightly less; in many places part of the original surface soil has been removed by sheet erosion; and some shallow gullies have formed. Both soils overlie the same parent material, a limestone containing a small quantity of calcareous shale.

Probably 5 percent of the land is under cultivation, but the yields are lower than those obtained on Colbert silt loam under similar cultural treatment. Its steep slope make it much more difficult to handle and more subject to serious erosion if devoted to clean-cultivated crops, compared with typical Colbert silt loam. About 50 percent of the land is now in pasture. A small proportion is considered idle land; that is, it is grown over with briars, sedges, and small bushes. The rest is in woodland consisting of a second growth of hardwoods and pine.

Surface drainage is good to excessive, but internal drainage is so slow that much of the rain water runs off the land rapidly. The best use for this land is pasture. It should be seeded to a good mixture of pasture grasses. Lime, together with phosphatic fertilizer, would be beneficial in obtaining a good stand of grass for pasture. It is probable that kudzu could be used profitably for reclaiming some of the gullied areas and checking erosion. Kudzu also would afford good grazing and would greatly improve the soil and supply it with the needed nitrogen. A volunteer growth of honeysuckle on the eroded areas is nature's method of reclamation.

Colbert silt loam, hill phase.—This soil occurs on the lower slopes of valley ridges. It occupies a very small area, principally in the vicinities of Trenton and Byrds Chapel. This soil is similar to Colbert silt loam, slope phase, except that it occupies slopes of 15 to 30 percent. Outcrops of limestone are numerous, the surface soil is thin, and bedrock is 15 inches or less below the surface.

A few small areas here and there are used for the production of corn, wheat, and hay. A considerable proportion of the land, formerly cleared and cultivated, has been abandoned because of its eroded condition. Most of the land, however, has remained in timber; the decaying roots have maintained a network of open root channels as natural drainageways for the passage of water and air into the impervious subsoil. Because of its steep slope, this soil is best adapted to permanent pasture or forest.

Colbert silt loam, shallow phase.—In the virgin condition, Colbert silt loam, shallow phase, has a 3-inch layer of light brownish-gray silt loam beneath a thin layer of dark-gray leafmold. The organic-matter content is low. Below this layer is grayish-yellow silty clay loam, which, at a depth of about 7 inches, rests on yellow heavy impervious silty clay that generally has some gray or yellow splotches. Limestone occurs from 15 to 18 inches below the surface.

This soil is closely associated with Colbert silt loam, its hill and slope phases, and rolling stony land (Colbert soil material). In many places erosion has removed all or most of the surface layer and the

impervious clay subsoil is near the surface. Bedrock is exposed in spots, particularly on eroded slopes. In some depressions and at the base of some slopes, where soil materials have accumulated, the surface layer is 10 or 12 inches thick.

Colbert silt loam, shallow phase, occurs in all parts of Lookout and Wills Valleys, although the total area is not large. The slope ranges from 2 to 8 percent and averages about 4 percent. The impervious subsoil, in places where the land has long been under cultivation, and the slight depth to bedrock prevent the internal movement of water and air. Internal drainage is better in the woodland and newly cleared land, where many old root channels allow some circulation. The texture and consistence of both the surface soil and the subsoil are such that generally enough water is absorbed and retained to provide for a good growth of lespedeza and bluegrass pasture in average years and some growth in dry years.

Almost all of this land was once cultivated, but failure to control surface wash resulted in the deterioration of perhaps 25 percent of the land. Some of it still is cultivated; 30 percent is devoted to permanent pasture; 10 percent is grown over with sedges, briars, and brush; and 10 percent is in forest, consisting largely of oaks, pines, cedars, and hickories. The percentage of cultivated land used for various crops and the treatment of such land are essentially like those features of the typical soil. Yields are much lower than those obtained on the typical soil, owing to depleted fertility, loss of organic matter through sheet erosion, more stoniness, and droughtiness. Corn yields from 10 to 20 bushels an acre, hay two-fifths to three-fifths of a ton, and wheat 7 to 12 bushels.

Marked depletion of inherent fertility through sheet erosion has made this land less suitable for crops. Under present economic conditions, it is better suited to pasture. The land could be improved materially, however, by liming and growing sweetclover, which would greatly enhance its carrying capacity as permanent pasture. The areas of deeper soils, with such an addition of organic matter and the opening up of the impervious subsoil with the large root channels, could be reclaimed for cultivated crops.

As 10 percent of this land has been protected from erosion by its forest cover and has, in this condition, fair moisture-absorbing and moisture-holding capacity, it would be profitable to remove the underbrush and part of the timber so that the sunlight could reach the ground and encourage the growth of mixed pasture plants—lespedeza, Dallis grass, timothy, Bermuda grass, white clover, and alsike clover. In many places where the bedrock is within 5 or 6 inches of the surface the reaction is neutral. In such places bluegrass does especially well early in the spring, but it dries rapidly as the season advances and the weather becomes warmer. If ground limestone is applied at the rate of 1 ton to the acre in places where the bedrock is 12 inches or more beneath the surface, sweetclover should grow well. This would supply much-needed organic matter and would penetrate the tight tough subsoil, thereby improving internal drainage, as well as water-absorbing and water-holding capacities.

Rolling stony land (Colbert soil material).—Rolling stony land (Colbert soil material), locally known as the "glades," represents a condition where limestone outcrops so completely cover the surface that it is not possible to break or cultivate the land with machinery.

Yellow or reddish-yellow heavy impervious clay, ranging from a few inches to several feet in thickness, occurs between the outcrops. West of Byrds Chapel and northwest of Cloverdale are small areas of red friable loam or silty clay loam, which have an inherent fertility higher than that of the Colbert soil material.

Only a decade or two ago farmers cultivated many of the areas now marked by numerous rock outcrops. Failure to terrace properly and grow strip and cover crops exposed the land to destructive erosion.

Rolling stony land (Colbert soil material) is more extensive than any of the soil types in the Colbert series. It covers an aggregate acreage of about 4.6 square miles. Areas occupied by this land type range from low, smooth ridges to steep, rough slopes. The average gradient is about 10 percent. Between rock outcrops, bluegrass and sweetclover make a good growth on the neutral soil materials early in the spring when moisture is adequate, but during a dry spell they practically die. The tree growth consists mainly of redcedar and black locust. Better pastures could be obtained if the brush were cut and trees thinned out so that the sunshine could reach the grasses. In places, water from perennial springs could be used with very little expense, other than for labor during slack seasons, for irrigation. These practices would assure good pasture in small areas here and there throughout the grazing season.

Fullerton silt loam, hill phase.—Soil of the hill phase differs from typical Fullerton silt loam principally in having slopes too steep for cultivation, and slighter depth to the underlying chert formation, which outcrops in many places. It is more droughty and lower in available plant nutrients than the typical soil. It differs from the hill phase of Colbert silt loam in having a pervious subsoil, although it is less pervious and cherty than in the hill phase of Clarksville cherty silt loam.

To a depth of about 3 inches, the virgin soil consists of light grayish-brown silt loam with some rather loosely combined organic matter and many angular chert fragments. Below this is light-red friable silty clay containing some cherty fragments. This material rests, at a depth ranging from 12 to 40 inches, on interstratified beds of chert and red clay.

Included with Fullerton silt loam, hill phase, are small areas of the eroded slope and eroded phases of Etowah silt loam. These aggregate about one-fourth of a square mile and occur on high terrace escarpments east and southeast of New England and east of Rising Fawn. Severe erosion has exposed the brownish-red sandy clay loam or clay subsoil in most places. In mapping, small areas of Fullerton silt loam and Colbert silt loam, hill phase, are included.

Fullerton silt loam, hill phase, does not cover a large total area. It occurs mainly on the lower slopes of chert ridges in Lookout Valley below the hill phase of Clarksville cherty silt loam and above the eroded phase of Fullerton silt loam. The largest areas are on the ridges both east and west of Wildwood, east and west of Morganville, and west of Rising Fawn. Smaller areas occur throughout Lookout and Wills Valleys. The extreme range of slope is from 15 to 50 percent, but the more common range is from 20 to 25 percent. The pervious surface soil and friable subsoil assure good surface and internal drainage, but the low content of organic matter so restricts

the water-absorbing and water-holding capacities of the soil that it tends to be droughty.

About 5 percent of this land is cultivated in small scattered patches, 20 percent is in permanent pasture, and 10 percent is in uncultivated fields grown up in old-field pines, briers, smilax vines, and brush. The rest represents cut-over land now covered with a second growth mostly of oaks and pines. Crops and agricultural practices are similar to those reported for Fullerton silt loam, but yields are decidedly lower. Corn yields about 8 bushels an acre and lespedeza hay one-half ton.

Because of erodibility, difficulty of cultivating steep slopes, droughtiness, and low yields, it would seem advisable that this soil should not be cultivated. It would have a good water-absorbing and fairly good water-holding capacity if an adequate quantity of organic matter could be incorporated in the surface soil. It would provide a fairly good pasture of lespedeza, orchard grass, and Bermuda grass, if the underbrush were removed and the timber thinned to admit the sunlight. Where gulying is more serious, kudzu would tend to hold the soil in place, enable the ditches to fill with wash from the slopes, supply organic matter, and provide good grazing. A volunteer growth of honeysuckle vines on these eroded slopes is a conspicuous part of nature's method of reclamation.

Clarksville cherty silt loam, hill phase.—Clarksville cherty silt loam, hill phase, is comparable to the typical cherty silt loam in its succession of soil layers, but it is unlike that soil in having thinner soil layers, a steeper slope, and more sheet erosion or gulying where farmed. Outcrops of the chert formation are numerous, and more chert fragments are scattered over the surface than on the typical soil.

The surface layer of the hill phase of Clarksville cherty silt loam consists of a 2- or 3-inch layer of gray cherty silt loam beneath about one-half inch of dark-gray organic matter. Underlying this is yellowish-gray or grayish-yellow cherty silty clay loam, which rests on beds of broken chert and heavy yellow silty clay at a depth of about 22 inches below the surface.

This soil occurs over steep, narrow cherty ridges throughout Lookout and Wills Valleys but is developed more extensively in the vicinity of Sulphur Springs. It covers a fairly large total area. The surface slope ranges from 15 to 60 percent and averages about 30 percent. Drainage is good to excessive. The openness of the soil allows rather free percolation of rain water, but the lack of organic matter allows rapid evaporation, so that the soil is very droughty.

Probably 2 percent of the land, consisting of the less sloping and smoother parts, is cultivated in small patches; 5 percent is in permanent pasture; and a few abandoned fields grown over with briers, sedges, and brush provide very inferior pasture. The rest of the land is forested with second-growth trees—mainly oaks and pines. The crops, fertilization, and management of this land are about the same as those for Clarksville silt loam, but yields are lower. This is due principally to lower inherent fertility, less organic matter, more erosion, more stoniness, and more droughty character because of the nearness of the bedrock to the surface.

Because of its steepness of slope and low content of plant nutrients, this land cannot be farmed economically; but some of that on the less sloping surfaces could be developed into fair pasture. The steeper slopes are covered with a natural forest growth, and the best use for such land is forest.

Hanceville silt loam, hill phase.—Under forest conditions the topmost 1- or 2-inch layer of Hanceville silt loam, hill phase, consists of reddish-brown silt loam with a fair content of well-combined organic matter. Beneath this is dull-red friable silty clay loam or silty clay, which grades at a depth of about 7 inches into dull-red firm but friable silty clay loam. This rests on bedrock at a depth ranging from 10 to 30 inches. Where the soil is cultivated, almost all of the organic layer and considerable of the subsoil has been eroded, gullies are common, and outcrops of bedrock are numerous.

This soil is developed in close association with the eroded phase of Armuchee silt loam and, as mapped, includes small areas of that soil.

The larger bodies of this soil are south of Byrds Chapel and south of Rising Fawn. The total area is very small. The soil occupies slopes ranging from 15 to 60 percent and averaging about 35 percent. Owing to the favorable texture and perviousness of the soil throughout, surface and internal drainage, as well as the water-absorbing and water-holding capacities, are very good.

About 40 percent of this soil is in uncultivated or abandoned old fields grown over with briars, bushes, and old-field pines; and 40 percent supports a second growth principally of oaks, pines, and hickories. The discontinuance of tillage has been due largely to sheet erosion and gullying.

Where the relief and surface soil allow cultivation, crops of cotton and corn return about 25 percent lower yields than on Dewey-Waynesboro silt loams, eroded phases, with similar fertilization. Cultivated areas are in great need of better terracing and winter cover crops. In fact, most of the slopes are too steep for any practical method of cultivation that conserves or improves the soil, but, because of the water-absorbing and water-holding capacities, the land could be used for pasture grasses. The pasture grasses recommended for Fullerton silt loam are suitable for this soil.

Reclamation of eroded slopes for permanent pasture requires the growing of kudzu, as this plant, because of its wide-spreading and deep-penetrating root system is able to hold the soil and provide pasture. Honeysuckle, which makes a voluntary growth in gullies, would also serve well in reclaiming badly eroded areas.

Armuchee silt loam, hill phase.—Armuchee silt loam, hill phase, has a 4- to 6-inch surface soil of brownish-gray silt loam containing very little organic matter. The subsoil consists of brownish-yellow or yellowish-red firm to heavy silty clay, which rests at a depth of about 18 or 20 inches on shale interstratified with a smaller quantity of thin bedded limestone. In many places all the surface soil has eroded, so that either the subsoil or beds of shale are exposed.

Combined with Armuchee silt loam, hill phase, in mapping, are about 2 square miles on steep slopes of ridges southwest of Byrds Chapel and in Lookout Valley near the Georgia-Tennessee line, where the material is more red throughout than typical. Another variation occupies several small areas, totaling about one-half of a square mile, in Lookout Valley in the northeast corner of the county. Here the

surface soil is more gray, the subsoil is more yellow, and the underlying formation is limestone.

Armuchee silt loam, hill phase, occurs on steep ridge slopes in all parts of Lookout and Wills Valleys but, particularly, near the Georgia-Tennessee line. The slopes range from 15 to 60 percent. The total acreage is not large. Run-off is rapid, as the heavy-textured subsoil and underlying shale formation retard the percolation of rain water. On the other hand, the texture favors the retention of moisture, so that this land withstands drought better than some of the lighter textured soils. Where forest fires have burned the organic matter on the surface and killed the trees and bushes, erosion has been serious and gullies are common.

This soil is not cultivated but supports a forest growth mainly of pines and oaks. Better pasture grass could be obtained by removing enough trees and underbrush in those areas where the slope ranges from 15 to 30 percent, so that the sunshine could reach the ground. Lespedeza, Bermuda grass, and orchard grass are recommended to be sown for pasturage.

Armuchee silt loam, eroded phase.—The eroded phase of Armuchee silt loam differs from the typical soil in that all or part of the original surface soil has in places been removed by erosion. Gullies and exposures of interstratified shale and limestone formations are common. The surface layer is brown friable silt loam, which grades at a depth of about 2 to 4 inches, into reddish-brown friable silty clay loam. This material continues to a depth of about 10 inches where the material is reddish-brown brittle silty clay. Beds of interstratified shale and limestone lie about 35 inches below the surface.

Patches of an eroded soil throughout Lookout Valley, totaling about one-third of a square mile, are included in mapping. They differ from Armuchee silt loam, eroded phase, in that they are grayer and only 18 inches thick over bedrock.

Armuchee silt loam, eroded phase, occurs in comparatively small bodies southwest of Byrds Chapel and in smaller areas throughout Lookout Valley. Its total area is very small. The slope ranges from 2 to 15 percent. Both surface and internal drainage are good, but rain water percolates so slowly that run-off is rapid, causing sheet erosion and gullying.

About 10 percent of this land is used for cultivated crops, and 50 percent is used for pasture. The pastures in many places are grown over with old-field pines, broomsedge, briers, and bushes. Uncleared areas support a growth of oaks, pines, and hickories. The cultivated land is used for corn, wheat, and hay; but yields are 30 percent lower than on typical Armuchee silt loam. Growth of crops is spotted and variable, owing to differences in content of organic matter, plant nutrients, moisture supply, and depth to the shale formation.

Where brush has been kept down, this land affords fair pasture. Pasturage, as a basis for livestock raising, is the best use for this soil. If kudzu or honeysuckle were planted on the gullied areas, they would prove very effective in reclaiming the soil as well as in providing some pasture.

Rough gullied land (Colbert and Armuchee soil materials).—Rough gullied land (Colbert and Armuchee soil materials) repre-

sents a land condition resulting from the removal of so much of the surface soil and subsoil and the formation of so many large gullies that reclamation by the farmer is no longer practicable. Reclamation of this gullied land can be accomplished only by the controlled growing of kudzu or honeysuckle in conjunction with reforestation to black locust. The slope ranges from $21\frac{1}{2}$ to 30 percent and averages about 7 percent.

This land occurs in association with the Colbert and Armuchee soils in a few very small bodies, chiefly east of Morganville and east of Byrds Chapel.

Atkins silt loam.—To a depth of 8 or 10 inches Atkins silt loam consists of gray or brownish-gray silt loam or very fine sandy loam, containing a fair quantity of organic matter. The subsoil is gray silt loam or silty clay loam, containing yellow or brown mottlings and extending to a depth of 40 or more inches. Field tests show medium acidity in both the surface soil and the subsoil.

Mapped with Atkins silt loam are about 80 acres of Atkins silty clay loam 1 mile southeast of Trenton, about 20 acres of Atkins fine sandy loam south of Trenton, about 80 acres of Dunning silty clay loam east and southeast of Rising Fawn, and 30 acres of Dunning silty clay loam three-fourths of a mile east and three-fourths of a mile south of Trenton. Compared with Atkins silt loam, Atkins silty clay loam is heavier textured throughout, Atkins fine sandy loam is lighter textured, and the Dunning soil has a heavier texture, darker color, and much higher content of organic matter.

Atkins silt loam covers only a small total area. It occurs northeast of Wildwood in depressions on the flood plain of Lookout Creek southeast and south of Trenton and on the first bottoms along intermittent tributaries of Lookout Creek. The soil material consists of sediments washed from soils overlying shale and sandstone, with an admixture of material from soils over limestone. Run-off is very slow, and water stands in depressions until it evaporates or percolates downward into the subsoil. Drainage is very poor and overflows are frequent.

Atkins silt loam is not cultivated but is used for pasture and forest. Its high content of organic matter and good supply of moisture favor the growth of permanent pasture. By cutting out the underbrush and thinning the trees so that the sunshine can reach the ground, much better pasture can be obtained. A mixture of lespedeza, Dallis grass, timothy, white clover, and alsike clover is recommended for seeding. With artificial drainage, the soil would rank among the best in the county for the production of corn and hay.

FIFTH-CLASS SOILS (FOREST LAND)

Fifth-class soils comprise Jefferson stony fine sandy loam; Hartsells fine sandy loam, slope phase; Hartsells fine sandy loam, shallow phase; Hartsells fine sandy loam, shallow slope phase; Hartsells very fine sandy loam, slope phase; Muskingum stony fine sandy loam; smooth stony land (Hartsells soil material); rough stony land (Muskingum and Hanceville soil materials); and rough stony land.

Classifying these soils and land types as forest land does not imply that they are better adapted to growing trees than any other soils in the county, but that forestry is the best use for them at present. These soils have many of the negative characteristics or conditions that disqualify them for cultivation, or even for pasture. In many places only

a very thin surface soil and subsoil are developed over rock, and in some places large rock outcrops are present. The slope is dominantly steep or very steep, gullies are common in places, run-off is rapid, and the moisture-holding capacity is restricted.

Jefferson stony fine sandy loam.—Jefferson stony fine sandy loam has a soil profile like Jefferson fine sandy loam, but it contains a large quantity of cobbles and boulders. It also resembles Jefferson fine sandy loam in its smooth to gently sloping relief, geologic origin of parent material, and drainage. It has a slope ranging from 0 to 7½ percent and averaging about 3 percent. The large quantity of sandstone cobbles and boulders, ranging in diameter from 1 to 30 or more inches, strewn over the surface and throughout the soil mass, makes cultivation impracticable. Because of its droughtiness, the land would afford only fair pasturage at best, even on the least stony areas. Therefore, its most profitable use is probably for forest.

Included with Jefferson stony fine sandy loam in mapping are small areas of Allen stony loam, aggregating about one-half of a square mile, along the base of Lookout Mountain north of Sulphur Springs and in Egypt Hollow. Its heavier texture makes it less susceptible to drought than the typical soil, so that it would support pasture grass part of the year. Another inclusion consists of a few acres of Pope loamy fine sand located 1 mile east of Trenton; and a third inclusion covers a total of about 8 acres, in small patches, of loose beds of rounded sandstone, gravel, and sand which occur in the flood plains of Lookout Creek 2½ miles southeast of Trenton and 3 miles south of Rising Fawn.

Jefferson stony fine sandy loam is closely associated with Jefferson fine sandy loam. The largest areas are east of Trenton and in Cole City Hollow. Smaller areas occur east and southeast of Rising Fawn and in Egypt and Murphy Hollows. This is not an extensive soil.

Hartsells fine sandy loam, slope phase.—Hartsells fine sandy loam, slope phase, is closely associated with the typical soil in small areas on slopes leading to creeks, branches, and small drainageways. The total extent is small. It differs from the typical soil in its thinner surface soil and subsoil, in slight depth to bedrock, which lies from 10 to 20 inches below the surface, and in the quantity of sandstone fragments scattered over the surface and throughout the soil mass. The slope ranges from 7½ to 15 percent. All this land is in forest, and because of its slope, droughtiness, and shallowness, this is considered the best use for it.

Hartsells fine sandy loam, shallow phase.—Hartsells fine sandy loam, shallow phase, is unlike the typical soil in that the underlying sandstone is close to the surface. Erosion is common and irregular fragments of sandstone are strewn over the surface. The surface soil to a depth of 6 inches is light grayish-yellow fine sandy loam containing very little organic matter. It is underlain by yellow or yellowish-brown friable fine sandy clay loam, which rests on sandstone or conglomerate at a depth ranging from 10 to 20 inches.

As mapped, this soil includes many small areas of Hartsells fine sandy loam and its shallow slope and slope phases.

Hartsells very fine sandy loam, shallow phase, is a common closely associated variation which occurs only in the northern parts of Lookout and Sand Mountains. The soil is similar to normal Hartsells very fine sandy loam but differs in its thinner soil layers. In spots

the subsoil is exposed; in others the surface soil rests directly on bedrock; and on some slopes and tops of knobs no soil remains over bedrock. An average profile of this inclusion has a gray friable very fine sandy loam surface layer, about $1\frac{1}{2}$ inches thick, underlain by a 6-inch layer of light grayish-yellow or yellowish-gray very fine sandy loam. This overlies yellowish-gray hard brittle clay loam, which at a depth of about 12 inches, rests on reddish-brown friable hard brittle clay loam or silty clay. At a depth of 15 or 16 inches a 2-inch layer of variegated reddish-yellow, yellowish-red, and yellow silty clay or silty clay loam occurs just above the beds of interstratified shale and sandstone. Some irregular-shaped fragments of sandstone and shale are scattered over the surface.

Hartsells fine sandy loam, shallow phase, occurs in close association with the typical soil. It occupies the ridge slopes and areas adjacent to steep slopes along streams. It occurs on low narrow ridges and on the sides of shallow valleys along intermittent streams on Lookout, Sand, and Fox Mountains. Good to excessive drainage, shallow surface soil and subsoil, very friable character, and low content of organic matter makes this soil very droughty.

The tree growth consists dominantly of oaks and pines. Virginia pine is more common than shortleaf pine, and chestnut oak is about as common as red oak. There are many post and blackjack oaks.

Probably 1 percent of this land is cultivated, and the rest is in forest. The cultivated land is farmed in conjunction with Hartsells fine sandy loam and Hartsells very fine sandy loam. Yields of crops are much lower than on those soils. Only where markets are readily accessible can this soil be profitably utilized for the production of early shallow-rooted crops, such as berries and vegetables. Even for such use, a large quantity of organic matter should be incorporated by turning under soiling crops. The best use of this land is for forest.

Hartsells fine sandy loam, shallow slope phase.—The shallow slope phase of Hartsells fine sandy loam covers a fairly large total area. It occurs on ridges, in close association with the shallow phase; but it is unlike that soil in that its surface gradient is from $7\frac{1}{2}$ to 15 percent, its surface soil and subsoil are thinner, more sandstone fragments are scattered over the surface and embedded throughout the soil mass, and outcrops of bedrock are more common.

This soil is nonarable and is best suited for forest.

Hartsells very fine sandy loam, slope phase.—This soil occurs as small bodies along drainageways within larger areas of Hartsells very fine sandy loam. Its total area is small. It has a thinner surface soil and subsoil than Hartsells very fine sandy loam. Interstratified sandstone and shale lie from 10 to 24 inches beneath the surface, and the surface gradient averages about 12 percent. This soil is covered with forest, which is considered its best use.

Muskingum stony fine sandy loam.—Muskingum stony fine sandy loam covers a fairly large area on Lookout and Sand Mountains. It occupies steep slopes, which range from 15 to 30 percent or more, generally below areas of the Hartsells soils.

Both the surface soil and the subsoil are shallow, and in places the surface soil rests directly on sandstone or conglomerate. Fragments of sandstone are strewn over the surface, and outcrops of sandstone and interstratified shale and sandstone are common.

None of this land is cultivated, but it supports a growth consisting of red oak and Virginia pine. Most of the original merchantable timber has been cut. Forest fires have not allowed the accumulation of vegetable matter on the surface and are in a large measure responsible for both sheet erosion and gullying. Because of the low inherent fertility of this soil, its droughtiness, and steep slopes, it is not well suited to the production of pasture grasses. It should remain in forest.

Smooth stony land (Hartsells soil material).—Smooth stony land (Hartsells soil material) occurs along small intermittent drainageways, and is associated in most places with the shallow phase and in some places with the shallow slope phase of Hartsells fine sandy loam. It differs from both in that the sandstone is within 10 inches of the surface and outcrops at such close intervals that cultivation is impracticable. The slope ranges from $2\frac{1}{2}$ to 15 percent. Because of the slight depth to sandstone, both surface and internal drainage are excessive. A second growth of oaks and pines has completely covered the surface, and its best use is for forest.

Rough stony land (Muskingum and Hanceville soil materials).—Rough stony land (Muskingum and Hanceville soil materials) occurs on the upper steep valley slopes of Lookout, Sand, and Fox Mountains. This rough land is underlain by sandstone, conglomerate, and some shale. It has the most broken and highly dissected relief of any land in the county. It consists of Muskingum and Hanceville soil materials, together with numerous outcrops of conglomerate, sandstone, and shale. Great blocks, from 5 to 40 feet in diameter, of sandstone have been slumped down from the ledges of rock outcrop or cliff above it. This soil classification is more extensive than any soil or other soil condition in Dade County. Its total area is about 30 square miles. Both surface and internal drainage are excessive, and the porous character of whatever soil material there is causes it to absorb rain water readily. Frequent forest fires not only destroy the timber but kill any start of carpet grass or lespedeza and lay bare the surface in many places, so that not only the surface soil and subsoil are washed away, but deep gullies are cut down to the underlying formation.

Red oak, shortleaf pine, Virginia pine, and mockernut (white) hickory are the principal trees, and post oak, blackjack oak, pignut hickory, black gum, and southern red oak are fairly common. Dogwood, redbud, and sassafras comprise the undergrowth.

This land is too broken, steep, and rocky for cultivation, and it is not adapted to pasture grasses because of its excessive drainage, rocky steep slopes, low amount of organic matter and plant nutrients, and droughtiness. It is not so well suited for forestry as glade or steep land, as it is difficult and expensive to harvest lumber where the relief is so broken and steep. It is recommended that the natural reproduction of trees be allowed to continue and that forest fires be prevented.

Rough stony land.—Rough stony land comprises the lower steep mountain slopes of Lookout, Sand, and Fox Mountains underlain by limestone. Narrower strips occur on the steep slopes in Cole City and Murphy Hollows. These slopes are dotted with limestone outcrops and great blocks of sandstone that have slumped from higher levels. Some of these blocks are as much as 40 feet in diameter. In addition to these, smaller irregular-shaped fragments of both limestone and sandstone are scattered everywhere over the surface. In places where

there is any soil it is gray friable silt loam underlain at a depth of about 5 inches by yellow or reddish-yellow heavy silt clay. Many intermittent streams have dissected these slopes deeply, so that it is very difficult to harvest and market the timber.

Rough stony land is adapted neither to cultivation nor pasture because of its inaccessibility, rocky character, and steep slopes. To obtain the best use of this land it should evidently be continued as a natural forest, and laws pertaining to incendiary forest fires should be very much more rigidly enforced. Repeatedly, even within the course of 1 year, a large part of these forests is burned. Thus the young growth is killed, the growth of all trees is retarded, and the organic matter in many places is completely burned off the surface, leaving the soil subject to destructive sheet erosion and gullyng.

MISCELLANEOUS CLASSIFICATION OF MATERIAL

Mine dump.—Areas mapped as mine dump consist largely of a series of long, narrow ridges, which range from 20 to 30 feet in height and from 5 feet at the top to 40 feet at the base in width. They represent strippings of shale and sandstone that were dumped as a result of mining coal on Lookout Mountain 3 miles southeast of Trenton also in mining iron ore in Wills Valley east of Rising Fawn.

Areas of mine dump are almost barren, except for a few dewberry vines and blackberry briers. Aside from the production of these berries mine dump has no agricultural value.

LAND USES AND MANAGEMENT

The best agricultural use to which the lands of Dade County can be put is dependent on many factors, among which are fertility, natural or developed tilth, amount and character of the organic matter in the surface soil, relief, drainage, texture, consistence, structure, soil reaction, degree of erosion, stoniness, ability to absorb and hold moisture, accessibility of markets, type of farming pursued, and, probably the most important of all, that personal equation that the farmer himself expresses. As changes are ever going on in the natural and social environments, as well as in the soil itself, the agricultural use of a soil must of necessity be modified from time to time in order to become adjusted to new conditions. A complete knowledge of the physical characteristics of the land, as expressed in a modern soil-survey map and report, furnishes a sound basis for classifying the results of farmers' experience and of experimental plots according to particular kinds of soil. In this way a farmer may have available to him the knowledge of others as to how his soil responds to management.

The farm practices that have prevailed generally in Dade County for many decades have tended toward deterioration of the land. Among these has been the failure to replenish the land by plowing under soil building crops. Thus, 99 percent of the land in this county is greatly in need of actively decomposing organic matter. Another mistake has been the cultivation of sloping land without proper terracing, strip crops, or cover crops. Consequently, erosion became very active, removed much of and in many places all of the virgin humus, and in addition cut gullies and exposed the bedrock so that in

many places the land became so infertile that cultivation was discontinued. Uncultivated fields throughout the farming sections are monuments to the careless, destructive work of yesterday. Again, 25 percent or more of the land of the county is burned over from one to five times annually. Most of this is rough stony woodland. These fires not only destroy the young trees, seriously damage all timber, and greatly retard growth, but also in many places burn out the organic matter that nature has been storing up in the soil through the centuries and thus denude the surface so that sheet erosion and gullying follow.

All these impoverishing land practices can be remedied successfully by introducing a constructive soil building and soil-conserving system of management. After discontinuing destructive burning, attention should be directed toward increasing and maintaining the organic matter, controlling erosion, preserving the present condition of tilth, and developing even better tilth. All the soils in Dade County are acid to strongly acid in reaction. A few areas of Pope silt loam, Talbott silt loam, and Colbert silt loam are the least acid soils. Practically all of the soils would be improved by the addition of lime. Particularly is this true where leguminous crops, especially clover, are to be grown. The quantity of lime that may be used profitably depends on the present condition of the soil, and before any large quantities are applied, it would be well to have the pH values determined on the soils of a particular field.

In table 5 are given the pH values of several important soils in Dade County.

Organic matter in soils tends to retard loss of moisture by surface evaporation; increases the moisture-absorbing and moisture-holding capacities; improves the tilth by making heavy soils more open, so

TABLE 5.—pH determinations of several soil profiles in Dade County, Ga.

Soil type and sample No.	Depth	pH	Soil type and sample No.	Depth	pH
Hartsells fine sandy loam:	<i>Inches</i>		Clarksville cherty silt loam:	<i>Inches</i>	
259701.....	0 - 1½	4.5	259727.....	0 - 1	5.3
259702.....	1½ - 3	4.8	259728.....	1 - 7	4.7
259703.....	3 - 16	4.6	259729.....	7 - 20	4.3
259704.....	16 - 23	4.4	259730.....	20 - 40+	4.4
259705.....	23 - 36	4.8	Alternathy silt loam:		
259706.....	36+	4.8	259735.....	0 - 8	5.6
Hartsells very fine sandy loam:			259736.....	8 - 24	5.3
259707.....	0 - 1½	5.5	259737.....	24 - 40	5.4
259708.....	1½ - 2½	4.7	Allen loam:		
259709.....	2½ - 16	5.0	259759.....	0 - 7	5.4
259710.....	16 - 18	4.8	259764.....	7 - 15	5.3
259711.....	18 - 33	4.7	259755.....	15 - 44	4.4
259712.....	33 - 58	4.6	259756.....	44 - 56	4.6
259713.....	58 - 66	4.6	Philo very fine sandy loam:		
259714.....	66 - 76	4.1	259757.....	0 - 6	4.2
Colbert silt loam:			259758.....	6 - 16	4.3
259715.....	0 - 7	5.2	259759.....	16 - 36	4.3
259716.....	7 - 11	7.0	Talbott silt loam:		
259717.....	11 - 20	6.8	259763.....	0 - 2	6.2
259718.....	20 - 30	4.6	259764.....	2 - 7	5.0
259719.....	30 - 40	4.6	259765.....	7 - 12	4.2
Fullerton silt loam:			259766.....	12 - 36	4.5
259720.....	0 - 7	5.0	259767.....	36 - 40	5.1
Fullerton silt loam (virgin soil):					
259721.....	0 - 1½	4.6			
259722.....	1½ - 7	4.0			
259723.....	7 - 15	4.8			
259724.....	15 - 34	4.6			
259725.....	34 - 60	4.4			
259726.....	60 - 90+	3.9			

that they are not so likely to puddle, run together, or erode; and fills the interstices of sandy soils, thus holding them together and decreasing leaching. It controls erosion by holding the soil in place and absorbing moisture that otherwise would run off the surface. In decomposing it supplies nitrogen and liberates other plant nutrients. In the green condition organic matter is actively decomposing, whereas old dry plants resist decomposition for years. Thus, it is important that the supply be either in the form of barnyard manure or green-manure crops. As the amount of barnyard manure is very inadequate, organic matter can best be supplied by growing and turning under legumes, including crimson clover, hairy vetch, lespedeza, cowpeas, soybeans, and Austrian Winter peas.

Some farmers supply their land with organic matter by interplanting cowpeas and soybeans with corn. After the corn has been topped and the ears have been snapped off, hogs and cattle are pastured on the peas and beans. What organic matter remains is turned under for cotton or another crop of corn. This is very helpful in maintaining a supply of actively decomposing organic matter but is insufficient for increasing the amount. A winter cover crop seems efficacious for increasing the content of organic matter in the land, as it reduces winter leaching, helps to prevent erosion, and does not interfere with the summer crop.

No systematic rotation of crops is generally practiced, but the rotation is usually determined by the type or phase of soil. For instance, on Hartsells fine sandy loam, cotton, corn, truck crops, and soybeans are the leading crops; on Hartsells very fine sandy loam, corn and truck crops are the more important; on the light-textured soils of Lookout Valley and other valleys, cotton and corn are the principal crops, and some wheat and lespedeza are grown; whereas on the heavy soils of these valleys, corn, wheat, and lespedeza are the main crops. On land subject to inundation along streams, corn is grown for the most part.

Experiments with cotton and corn on Hartsells fine sandy loam on the farm of the Sand Mountain Substation near Crossville, Ala., gave 6-year averages as high as 1,730 pounds of seed cotton and 57.7 bushels of corn per acre. To obtain such yields, both cotton and corn succeeded hairy vetch, and 600 pounds of 0-10-4 commercial fertilizer was used for cotton and the same quantity of 4-8-4 for corn.

As the above-described experiments were conducted on Hartsells fine sandy loam under similar climatic conditions to those of Sand and Lookout Mountains of Dade County, it is probable that comparable results might be obtained on Hartsells fine sandy loam in this county. It is also believed that Hartsells very fine sandy loam would respond favorably to the same treatment.

The Agricultural Division of the Tennessee Valley Authority applied 100 pounds of triple superphosphate and 300 pounds of ground limestone on Hartsells fine sandy loam of Sand Mountain on Dr. R. E. Owenbey's farm about 3 miles west of Trenton. The result was an increase of 182 percent in yield of crimson clover. The acre yield was 3.53 tons.

Korean lespedeza comprises 80 percent of the hay produced in the valley, and it is important in the cultivated pastures. Kobe, Sericea, and Tennessee 76 lespedeza, as well as soybeans, cowpeas, white beans, oats, and other cultivated hays, are grown. The uncultivated hay is

largely a mixed volunteer growth of Bermuda grass, redtop, and lespedeza. Crimson clover is proving a very satisfactory winter crop. Based on results gained locally, crimson clover and hairy vetch are recommended as winter cover crops to be rotated with cotton and corn. Crimson clover is preferable, because of its seed for subsequent plantings.⁹

The University of Georgia recommends the following 3-year rotation as a well-balanced farm program for Fullerton silt loam, Etowah silt loam and its eroded phase, and Allen loam: Cotton for the first year, corn interplanted with a summer legume and preceded with a winter legume for the second, and small grain succeeded by cowpeas, soybeans, or lespedeza for the third. Bermuda grass, orchard grass, and lespedeza are considered good pasture grasses. Dewey-Waynesboro silt loams, eroded phases; Talbott silt loam; and Armuchee silt loam respond favorably to a similar rotation and the same pasture grasses. For Hartsells fine sandy loam and Hartsells very fine sandy loam a 2-year rotation is recommended. This consists of corn interplanted with cowpeas or soybeans and preceded with a winter legume for the first year and truck crops succeeded by cowpeas or soybeans for hay the second. For Colbert silt loam, colluvial phase, a winter legume should be followed by corn interplanted with a summer legume for the first year; small grain succeeded by lespedeza, cowpeas, or soybeans for the second; and grass and legumes for grazing for the third. Pasture can be established on this land by sowing Dallis grass, lespedeza, timothy, white clover, and alsike clover after an application of phosphorus and lime. Colbert silt loam is best used for pasture, which should be established by first treating the land with phosphorus and lime, and afterward sowing Bermuda grass, Dallis grass, timothy, lespedeza, white clover, and alsike clover. Crimson clover should be added in the fall. To control weeds, grasses should be mowed two or three times a year and grazed closely. Pope silt loam should have a leguminous winter cover to prevent washing during inundation. This should be followed by corn interplanted with summer legumes; the second year, small grain should be succeeded by lespedeza, cowpeas, or soybeans; and the third year, truck crops should be grown. If the land is to be used for pasture Dallis grass, timothy, lespedeza, white clover, and alsike clover would give good results.

The production of livestock might be profitably extended provided suitable pastures could be developed. Well distributed throughout Lookout Valley is an aggregate of about 25 square miles of potential good pasture land, which, at present, is in uncultivated fields or wood-lot pastures. These, by thinning out the trees, removing underbrush, and sowing to grasses, are capable of increasing the amount of pasture fourfold. The available land in Lookout Valley best suited for pasture is that which has a fair to good moisture-holding capacity such as the Armuchee, Abernathy, Colbert, Fullerton, Etowah, Talbott, Dewey-Waynesboro, Pope, and Atkins silt loams, their phases and variations, and, in addition, Philo very fine sandy loam.

These recommendations for pasture on Colbert silt loam apply also to Colbert silt loam in places where the limestone is 1 foot or more below the surface. Recommendations for Colbert silt loam, colluvial phase, apply to Talbott silt loam; those for Fullerton silt loam, Eto-

⁹ This and similar information throughout this section were obtained from the country agricultural agent.

wah silt loam, and Allen loam apply to all phases of these soils and to Dewey-Waynesboro, Armuchee, and Clarksville soils; those for Pope silt loam apply to Philo fine sandy loam and Atkins silt loam where adequate drainage has been provided.

Ever since man first cleared and put under cultivation the lands of Dade County, erosion has stood forth as the greatest destroyer of the farm. Where cultivated at present or in the past, about 75 percent of the land in the mountains and 96 percent of that in the valleys show distinct evidence of erosion. In the mountains about one-fourth of the eroded land has up to 25 percent of the original surface soil gone and about one-tenth has from 25 to 50 percent washed away. These latter areas show some gullying. In the valleys 99 percent of the land that is or has been cultivated on the upland, 95 percent on the terraces, and 5 percent on the flood plains along streams are eroded. Of the upland, such as the Armuchee, Colbert, Fullerton, Talbott, and Dewey-Waynesboro soils, and such terrace land as Etowah and Sequatchie, fully one-half of the original surface soil is gone from 50 percent of it, three fourths from 25 percent, between one-fourth and one-half from 20 percent, and less than one-fourth from the remainder.

Among causes of erosion in Dade County are rainfall, degree of slope, erodibility, and soil management. The more erosive rains come in heavy downfalls when the surface is bare. In a newly plowed field after a heavy rain it was observed that a considerable part of the surface soil was lost and that a veritable network of small gullies had developed. The steeper the slope, the greater the degree of erosion where there is not a heavy vegetal covering; but in areas covered with such vegetation as forest, good permanent pasture, and a good stand of lespedeza or other hay there is little difference, if any, in the degree of erosion on lands with surface slopes ranging from 4 to 10 degrees.

The erodibility of lands, owing to soil characteristics, is important. Pervious soils like Clarksville cherty silt loam, Hartsells fine sandy loam and very fine sandy loam, Fullerton silt loam, Jefferson fine sandy loam, Allen loam, and Sequatchie fine sandy loam allow rapid percolation of rain water into both the surface soil and the subsoil, so that the run-off is comparatively much less from a particular rain than on Colbert, Talbott, Armuchee, or Dewey-Waynesboro silt loams, which have heavier textured soils. In the latter soils rain water enters slowly and accumulates rapidly at or near the surface, so that a larger amount and higher velocity of run-off is produced. The organic content is also directly related to soil erodibility. It is a natural absorptive, decreases run-off, and thus lessens the erosion. As the organic matter is depleted through careless cultivation, the resistance to erosion is lowered.

Of all factors determining degree of erosion in the soil, the human factor, as expressed in soil management, is the most important. For a guide to control of erosion let us turn to nature which, with its forests, grasses, and millions of roots and rootlets, has held the land intact for many centuries. Only where fires destroyed the timber and organic matter did erosion and gullying take place. In the virgin forests soils on slopes of 30 percent show very little erosion, whereas, with the same types of soils on slopes of 4 percent, intensely cropped fields contain many gullies and have lost most of their surface soil.

The farmer cannot control the weather or very well change the degree of slope, but he can check erosion by introducing a system of management wherein he maintains cover crops on his land during the winter, grows strip cover crops during the summer where needed, terraces his erosive land, practices contour cultivation, and increases the content of organic matter in his soil through proper rotations. A Soil Conservation and Improvement Association was organized by the farmers in 1935. Many of the members of this association have put into practice the constructive measures mentioned above to combat soil erosion on their farms. Recently, the association purchased a power terracing tractor. It makes a charge of \$2.40 per hour for the period of actual operation on a farm.

Farmers of Dade County could very profitably devote more attention to their home subsistence gardens. The garden site should be free from erosion and weed seed. The soil should be well drained, well aerated, warm, friable, and mellow; it should respond quickly to fertilizer, and be capable of development into a good seedbed. If possible this site should be where spring water is available for irrigation, as droughts frequently are serious setbacks in this locality.

On many farms, especially in the valleys, water could easily be provided. Where water is scarce, the incorporation of organic matter together with a deep, well-tilled seedbed is imperative, as the deeper the seedbed and the finer the soil particles, the more water it will retain. On heavy soils, such as Colbert silt loam, the ground should be broken in the fall, so that it will mellow under the influence of freezing and thawing. Stirring the soil every week or two during the spring not only will free it of weeds but will break capillary attraction and prevent much evaporation. Stable manure and green-manure crops should be plowed under in time to decay thoroughly before vegetable crops are planted.

Stable manure is the best garden fertilizer, and an annual treatment of 20 wagonloads per acre is recommended. This can be applied broadcast in the spring. In addition to the manure a broadcast application of 1,000 to 2,000 pounds per acre of a fertilizer, analyzing 3 to 4 percent nitrogen, 8 to 10 percent phosphoric acid, and 6 to 10 percent potash, is beneficial.

In order to avoid insects and diseases it is well to set apart about three garden areas and follow a 3-year rotation. Crops, such as corn, wheat, and crimson clover used in the rotation, should not be host plants to diseases commonly attacking vegetables.

In addition to better gardens, more truck and fruit crops might be grown. The following crops are recommended after increasing the content of organic matter by growing hairy vetch or crimson clover: Apples for Hartsells very fine sandy loam, early vegetables for Hartsells fine sandy loam, peaches for Fullerton silt loam, and summer and fall vegetables for Allen loam.

FORESTRY ¹⁰

In the early agricultural development of Dade County, it was necessary for the settlers to remove the virgin forests which completely covered the region. A very close relationship exists between the character of the natural forest growth and the soils, this being most

¹⁰ All information pertaining to forests in this report was obtained from Du Pre Barrett, Extension Forester for The University of Georgia, State College of Agriculture.

obvious where the bedrock is well beneath the surface or close to it.

Where the bedrock (sandstone, conglomerate, or interstratified sandstone and shale) is 2 feet or more beneath the surface, the tree growth on Lookout, Sand, and Fox Mountains consists dominantly of red oak with considerable chestnut oak, mockernut (white) hickory, pignut hickory, shortleaf pine, and some white oak, post oak, blackjack oak, black gum, sweetgum, white ash, black ash, Virginia pine, sassafras, and persimmon. Where the bedrock is within 2 feet of the surface, Virginia pine is the dominant growth, with a large amount of red oak, post oak, blackjack oak, and black gum. On the rough stony mountain slopes red oak predominates; but post oak, blackjack oak, Virginia pine, mockernut hickory, pignut hickory, redcedar, black locust, and dogwood are abundant over the limestone, and Virginia pine, mockernut hickory, pignut hickory, post oak, blackjack oak, and chestnut oak are abundant over the sandstone. In Lookout Valley where the limestone is near the surface as with the shallow and shallow slope phases of Colbert silt loam, redcedar, black locust, red oak, Virginia pine, and black gum are common. Where the limestone is at a greater depth, loblolly pine, shortleaf pine, red oak, white oak, mockernut hickory, and pignut hickory are well represented. On chert ridges in Lookout Valley, where Clarksville cherty silt loam and Fullerton silt loam, with their various phases, are the principal soils, yellow oak, black oak, red oak, white oak, Virginia pine, and black gum are important. Trees of less importance in Lookout Valley and on the mountain slopes are southern red oak (Spanish oak), willow oak, mulberry, white cedar, dogwood, beech, red maple, sugar maple, shellbark hickory, wild cherry, birch, white oak, overcup oak, chinquapin, black locust, honeylocust, black gum, sweetgum, black ash, white ash, basswood, tuliptree, cucumbertree, persimmon, black walnut, butternut, hackberry, redbud, white elm, winged elm, slippery elm, horsechestnut, buckeye, crab apple, plum, sycamore, willow, alder, hawthorn (red haw), blackhaw, nannyberry (sugar haw), boxelder, sumac, papaw, sourwood, ironwood, shadblow (serviceberry), sassafras, hazel, and birch.

Over 60 percent of Dade County is naturally adapted to no other productive use than forests. This includes all the rough stony land (Muskingum and Hanceville soil materials) and Muskingum stony fine sandy loam of Lookout Valley as well as of Cole City, Murphy, and Egypt Hollows; the slope, shallow, and shallow slope phases of Hartsells fine sandy loam, slope phase of Hartsells very fine sandy loam, smooth stony land (Hartsells soil material), and Muskingum stony fine sandy loam on the mountaintops; and Jefferson stony fine sandy loam, and Clarksville cherty silt loam, steep phase, of Lookout Valley.

It is estimated that over 75 percent of the timberland of this county is burned over annually. Such burning destroys the natural reproduction and organic matter, severely injures trees of 15 to 20 inches in diameter by burning the cambium, thus subjecting them to the infestations of insects and plant diseases, and retards development of larger trees.

The vast uncultivated areas of the mountaintops, rough broken valley slopes, and valley ridges, where bare or thin, would naturally reseed if any seed trees were within a quarter of a mile. If artificial reforestation is used, however, loblolly pine (*Pinus taeda* L.), red-

cedar (*Juniperus virginiana* L.), and common locust or black locust (*Robinia pseudoacacia* L.) are recommended. The latter is especially good for fence posts. In numerous places the young growth is entirely too thick, and thinning should be done during the season that the trees are dormant. By this means growth could be stimulated considerably.

A very serious practice in vogue is that of cutting trees as small as 12 inches and less in diameter. No tree less than 15 inches in diameter and 3 feet in height above ground should be cut, and one or more seed trees should be left standing on each acre.

PRODUCTIVITY RATINGS AND LAND CLASSIFICATION

In table 6 the soils of Dade County are listed alphabetically, and the estimated average acre yields of the principal crops are given for each soil.

These estimates are based primarily on interviews with farmers, the county agricultural agent and his assistant; members of the Georgia Agricultural Experiment Station staff cooperating with the College of Agriculture staff, and others who have had experience in the agriculture of Dade County. As such, they are presented only as estimates of the average production over a period of years according to two broadly defined types of management. It is realized that they may not apply directly to specific tracts of land for any particular year, inasmuch as the soils as shown on the map vary somewhat, management practices differ slightly, and climatic conditions fluctuate from year to year. On the other hand, these estimates appear to be as accurate information as can be obtained without further detailed and lengthy investigations, and they serve to bring out the relative productivity of the soils shown on the map.

The figures in the column headed A under each crop indicate yields obtained under the prevailing practices, which commonly include the use of small to moderate amounts of commercial fertilizers but which generally do not include careful and intensive practices of soil management in regard to erosion control, incorporation of organic matter, and maintenance and increase of soil productivity. In the column headed B, yields under more careful and intensive practices are given. These practices consist of a regular crop rotation, including the growing of legumes, the use of barnyard and green manures, application of lime and liberal quantities of suitable commercial fertilizers, use of improved varieties and high-quality seed, and, where needed, use of mechanical measures, such as contour tillage, strip cropping, and terracing or constructing diversion ditches for the control of erosion. In the poorly drained soil of the bottoms—Atkins silt loam—artificial drainage is provided.

The practice in vogue in Lookout Valley is to apply 100 to 200 pounds per acre of a 4-10-4 mixture for cotton. Corn follows cotton and receives no fertilizer. Wheat is sown on cornland in the fall. On the mountains cotton land receives from 300 to 600 pounds of a 2-10-2 or 5-15-5 mixture. If a truck crop takes the place of cotton, the land receives a moderate application of fertilizer. Corn succeeds both cotton and truck crops without fertilizer. Phosphate alone is used on corn and wheat where they are grown alone and not in rotation with cotton or truck.

TABLE 6.—*Estimated average acre yields¹ of the principal crops on each soil in Dade County, Ga.*

Soil (soil types, phases, and land types)	Lint cotton		Corn		Wheat		Lespedeza		Pasture ²
	A	B	A	B	A	B	A	B	
	<i>Lb.</i>	<i>Lb.</i>	<i>Bu.</i>	<i>Bu.</i>	<i>Bu.</i>	<i>Bu.</i>	<i>Tons</i>	<i>Tons</i>	<i>Cow-acre-days</i>
Abernathy silt loam.....									
Allen loam.....	275	375	20	40	12	18	1.35	1.5	140
Armuchee silt loam.....	250	350	15	25	10	18	1	1.5	110
Armuchee silt loam, eroded phase.....									100
Armuchee silt loam, hill phase.....									90
Atkins silt loam.....				50					70
Clarksville cherty silt loam.....	240	350	15	25	8	12	1	1.35	110
Clarksville cherty silt loam, hill phase.....									80
Colbert silt loam.....			15	25	10	14	1	1.75	90
Colbert silt loam, colluvial phase.....	250	300	18	40	10	18	1	1.5	120
Colbert silt loam, hill phase.....									70
Colbert silt loam, shallow phase.....	200	250	10	20	7	12	.5	1	80
Colbert silt loam, slope phase.....			10	20	6	11	.5	.9	80
Dewey-Waynesboro silt loams, eroded phases.....	250	300	20	45	12	19	1	1.35	100
Etowah silt loam.....	275	375	25	50	12	20	1	1.6	110
Etowah silt loam, eroded phase.....	240		20	42	10	19	.8	1.2	100
Etowah silt loam, eroded slope phase.....	200		12	37	8	17	.6	1.2	90
Fullerton silt loam.....	275	440	20	35	10	19	1	1.5	110
Fullerton silt loam, eroded phase.....	225		17	32	8	15	.75	1.1	90
Fullerton silt loam, eroded slope phase.....	210		15	30	8	15	.7	1.1	80
Fullerton silt loam, hill phase.....			8				.5		80
Fullerton silt loam, slope phase.....	240	275	15	37	8	16	1	1.35	100
Hanceville silt loam, hill phase.....									70
Hartsells fine sandy loam ⁴	225	500	15	50	12	25	.75	1.1	70
Hartsells fine sandy loam, shallow phase.....	150		10				.4		
Hartsells fine sandy loam, shallow slope phase.....									
Hartsells fine sandy loam, slope phase.....									
Hartsells very fine sandy loam ⁴	200	350	13	25	10	16	.6	1.1	65
Hartsells very fine sandy loam, slope phase.....									
Jefferson fine sandy loam.....	210		15	32	8	15	.6	1	70
Jefferson stony fine sandy loam.....									
Mine dump.....									
Muskingum stony fine sandy loam.....									
Philo very fine sandy loam.....			25	40			1	1.5	120
Pone fine sandy loam.....			25	40			1	1.2	80
Pope silt loam.....			30	50	10	20	1.25	1.6	130
Rolling stony land (Colbert soil material).....									
Rough gullied land (Colbert and Armuchee soil materials).....									70
Rough stony land.....									
Rough stony land (Muskingum and Hanceville soil materials).....									
Squatchie fine sandy loam.....	275	400	20	35	10	20	.75	1.5	85
Smooth stony land (Hartsells soil material).....									
Talbot silt loam.....	220	275	20	30	10	18	1	1.1	100

¹ Yields in column A indicate the average crop obtained under prevailing practices; those in column B the average crop obtained with improved methods of farm management. Absence of a yield figure indicates that the crop is not commonly grown or that data are lacking.

² These estimates are for pasture after treatment with lime and phosphate, and it must be emphasized that they are definitely estimates. Cow-acre-days refers to the product of the number of animal units carried per acre and the number of days the animals are grazed without injury to the pasture. For example, the soil capable of supporting 1 animal unit per acre for 360 days of the year rates 360, whereas another soil capable of supporting 1 animal unit per 2 acres for 180 days of the year rates 90.

³ Improvements include adequate drainage. The practicability of drainage, however, depends on the size and shape of the area and the use to be made of the land.

⁴ These soils are used to grow vegetables and produce the following yields of three of the most important:

	Potatoes	Sweetpotatoes	Tomatoes
	<i>Bushels</i>	<i>Bushels</i>	<i>Bushels</i>
Hartsells fine sandy loam.....	100	90	200
Hartsells very fine sandy loam.....	95	85	190

⁵ Data for improved practices taken from data by the Sand Mountain Substation Experiment Farm, Alabama.

TABLE 7.—*Productivity ratings of the soils of Dade County, C.*

Soil (soil types, phases, and land types) ¹	Crop productivity index ² for—										G Grass cov- days	A
	Cotton (100=400 pounds)		Corn (100=50 bushels)		Wheat (100=25 bushels)		Lespedeza (100=1.6 T)		Pasture ³ (100=100 cov- days)			
	A	B	A	B	A	B	A	B				
Abernathy silt loam.....			80	100			90	100			140	
Pope silt loam.....			50	100	40	80	85	110			130	
Etowah silt loam.....	70	95	50	100	50	80	65	110			110	
Allen loam.....	70	110	40	80	50	70	65	95			110	
Fullerton silt loam.....	70	100	40	70	40	75	65	100			110	
Dewey-Waynesboro silt loams, eroded phases.....	90	100	40	70	40	75	65	90			100	
Sequatchie fine sandy loam.....	90	100	40	70	40	80	50	100			85	
Sequatchie fine sandy loam, eroded phase.....	90	75	40	70	40	75	65	100			85	
Colbert silt loam, colluvial phase.....	90	70	30	75	40	70	65	90			100	
Fullerton silt loam, slope phase.....	90	70	30	75	40	70	65	90			100	
Armuchee silt loam.....	60	85	30	50	40	70	65	100			70	
Hartsells fine sandy loam.....	55	125	30	50	40	70	65	100			60	
Talbot silt loam.....	55	90	40	60	40	60	40	70			100	
Hartsells very fine sandy loam.....	50	25	50	50	40	60	40	60			65	
Pope fine sandy loam ⁴			50	80			65	80			80	
Phila very fine sandy loam.....			50	80			65	100			120	
Clarksville cherty silt loam.....	60	85	20	50	30	50	65	90			80	
Fullerton silt loam, eroded phase.....	60	85	25	65	30	60	50	75			90	
Etowah silt loam, eroded slope phase.....	90	25	25	75	30	70	40	80			90	
Jefferson fine sandy loam.....	90	30	30	65	30	60	40	70			70	
Fullerton silt loam, eroded slope phase.....	90	30	30	60	30	60	45	75			80	
Colbert silt loam.....	90	30	30	60	30	60	50	70			90	
Colbert silt loam, shallow phase.....	50	60	20	40	30	50	35	70			80	
Fullerton silt loam, hill phase.....	20	60	25	50	35	70	80	80			80	
Colbert silt loam, slope phase.....	20	40	25	45	35	70	80	80			80	
Atkins silt loam.....	20	7	100	110	7	100	110	110			110	
Armuchee silt loam, eroded phase.....											90	
Hanceville silt loam, hill phase.....											70	
Clarksville cherty silt loam, hill phase.....											70	
Armuchee silt loam, hill phase.....											70	
Colbert silt loam, hill phase.....											70	
Rolling stony land (Colbert soil material) ⁵											70	
Rough gullied land (Colbert and Armuchee soil materials) ⁵											70	

See footnotes at end of table.

TABLE 7.—*Productivity ratings of the soils of Dade County, Ga.—C*

Soil (soil types, phases, and land types)	Crop productivity index for—									
	Cotton (100=400 pounds)		Corn (100=50 bushels)		Wheat (100=25 bushels)		Lespedeza (100=1.5 T)		Pasture (100=100 cow-acre- days)	
	A	B	A	B	A	B	A	B	A	B
	35	---	20	---	---	---	30	---	---	---
Hartsells fine sandy loam, shallow phase.....	---	---	---	---	---	---	---	---	---	---
Jefferson stony fine sandy loam.....	---	---	---	---	---	---	---	---	---	---
Hartsells fine sandy loam, slope phase.....	---	---	---	---	---	---	---	---	---	---
Hartsells very fine sandy loam, slope phase.....	---	---	---	---	---	---	---	---	---	---
Hartsells fine sandy loam, shallow slope phase.....	---	---	---	---	---	---	---	---	---	---
Muskingum stony fine sandy loam.....	---	---	---	---	---	---	---	---	---	---
Smooth stony land (Hartsells soil material)	---	---	---	---	---	---	---	---	---	---
Rough stony land (Muskingum and Hanceville soil materials)	---	---	---	---	---	---	---	---	---	---
Rough stony land.....	---	---	---	---	---	---	---	---	---	---
Mine dump.....	---	---	---	---	---	---	---	---	---	---

¹ The soils are listed in the approximate order of their general productivity under the prevailing practices of soil management, the most productive first.

² The soils are given indexes to show the approximate average production of each crop in percent of the standard of reference. The standard represents the approximate average yield obtained without the use of amendments on the more extensive and better soil types of those regions of the United States in which the crop is most widely grown. The indexes are based largely on estimates of yields (see table 6), as yield data are too fragmental to be adequate. Indexes in column A refer to average yields obtained under prevailing practices, whereas indexes in column B refer to average yields obtained under improved methods of soil management that include crop rotations, erosion control practices, the use of legumes, commercial fertilizers, lime, and barnyard and green manures. Absence of an index indicates that the crop is not commonly grown or that data are lacking.

³ See footnote 2, table 6.

⁴ These numbers indicate the general under two general levels of management.

⁵ This is a generalized statement of soil productivity.

⁶ This is a grouping of soil types and is based on such considerations of soil productivity.

⁷ This index is for improved productivity of drainage, however, desirable.

⁸ Yields for improved practices Experiment Farm, Alabama.

⁹ Fope fine sandy loam as mapped. As a result, it is grouped in the type.

In order to compare directly the yields obtained in Dade County with those obtained in other parts of the country, yield figures have been converted in table 7 to indexes based on standard yields. The soils are listed in the approximate order of their general productivity under prevailing farming practices, the most productive at the head of the table.

The rating compares the productivity of each of the soils for each crop to a standard, namely, 100. This standard index represents the approximate average acre yield obtained without the use of amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. An index of 50 indicates that the soil is about half as productive for the specified crop as is the soil with the standard index. The standard yield for each crop shown in table 7 is given at the head of each respective column. Soils given amendments, such as lime and commercial fertilizers, or special practices, such as irrigation, and unusually productive soils of small extent may have productivity indexes of more than 100 for some crops.

The principal factors affecting the productivity of land are climate, soil (this includes the many physical, chemical, and biological characteristics), slope, drainage, and management, including the use of amendments. No one of these factors operates separately from the others, although some one may dominate. In fact, the factors listed may be grouped simply as the soil factor and the management factor, since slope, drainage, and most of the aspects of climate may be considered characteristics of a given soil type. The soil type occupies specific geographical areas characterized by a given range of slope and climatic conditions. Crop yields over a long period of years furnish the best available summation of the association factors and, therefore, are used where available.

Economic considerations play no part in determining the crop productivity indexes. The indexes cannot be interpreted, therefore, into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land. It is important to realize the productivity, as measured by yields, is not the only consideration that determines the relative worth of a soil for growing crops. The ease or difficulty of tillage and the ease or difficulty with which productivity is maintained are examples of considerations other than productivity that influence the general desirability of a soil for agricultural use. In turn, steepness of slope, presence or absence of stone, resistance to tillage offered by the soil because of its consistence or structure, and size and shape of areas are characteristics of soils that influence the relative ease with which they can be tilled. Likewise, inherent fertility and susceptibility to erosion are characteristics that influence the ease of maintaining soil productivity at a given level. Productivity, as measured by yields, is influenced to some degree by all these and such other factors as the moisture-holding capacity of the soil and its permeability by roots and water. These latter should not be considered entirely separately from productivity, but, on the other hand, schemes of land classification to designate the relative suitability of land for agricultural use must give some separate recognition to them.

In the column headed "Grouping according to physical use adaptations," the soils are grouped according to their comparative desir-

ability or physical suitability for crop growing, grazing, or forestry.

The soils are listed in table 7 in the order of their general productivity according to the prevailing practices (indexes in column A). In the columns under "General productivity," "Grade," productivity grade numbers are assigned for crop indexes A and B. The general productivity grade is based on a weighted average of the indexes for the various crops, the weighting depending on the relative acreage and value of the crop. If the weighted average is between 90 and 100, the soil type is given a grade of 1; if it is between 80 and 90, a grade of 2 is given, and so on.¹¹ Since it is difficult to measure mathematically either the exact significance of a crop in the agriculture of an area or the importance or suitability of certain soils for particular crops, perhaps too much significance may be given to the order in which the soils are listed. On the other hand, the arrangement does give information as to general productivity. General productivity group is a broad grouping to bring out in general terms the relative productivity of the soils of Dade County.

Productivity tables do not present the relative roles that soil types, because of their extent and the pattern of their distribution, play in the agriculture of the county. The tables show the relative productivity of individual soils. They cannot picture in a given county the total quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil type devoted to each of the specified crops.

The best soils of the county, classified as Second-class soils, are considered good to fair cropland. They are, in general, capable of medium to moderately high production of the crops commonly grown under good soil-management practices; they are rather easily worked, and it is not especially difficult to maintain their productivity. They are not considered First-class soils as their inherent fertility is not equal to that of such soils of the Tennessee Valley as the Huntington and Decatur.

Third-class soils are considered fair to poor cropland. They are of medium to low productivity and generally occur on steeper slopes than the Second class soils. As a result, they generally are more difficult to till and to protect against loss from erosion. Pope fine sandy loam, which is included in this group because of the variability of the areas that are included with it in mapping, is commonly considered a Second-class soil.

The Fourth-class soils as a group are more difficult to till, either because of increased slope, impervious subsoils, or stoniness; are lower in productivity; and have experienced more erosion than the Third-class soils. Because of a fair degree of fertility and moisture-holding capacity most of them can be managed so as to be fair to good pasture land. Atkins silt loam needs artificial drainage to be productive for tilled crops, but in its undrained condition it can be made very productive of pasture grasses. These soils are used to good advantage for pasture on most farms. Their distribution in relation to either better or poorer soils on any farm, of course,

¹¹ Since cotton and corn are the principal crops in Dade County, the following weighting is used for most of the soils: Cotton 40, corn 40, wheat 10, and lespedeza 10. Adjustments are made on some of the soils, such as those of the bottom lands, where corn is weighted 70 in some instances.

is very influential in determining the best use of any one of these soils on any particular farm.

The Fifth-class soils comprise comparatively rough, stony, and mountainous areas. They are too rugged for pasture, and their best use over a period of years appears to be for forest.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of forces of weathering and soil development on soil materials deposited or accumulated by geological agencies. The characteristics of the soil at any given point depend on the internal soil climate, native vegetation, composition of the parent material, and the length of time the forces of soil development have acted on the soil material. Soil climate, in turn, depends on the usual climatic factors of rainfall, temperature, and humidity, and locally is greatly modified by relief as it affects drainage, aeration, and run-off.

Dade County lies in the Red and Yellow soils region of the United States. The soils are dominantly podzolic, although there is some evidence of laterization, the soils having developed in a temperate humid climate. The average annual rainfall is about 52 inches, and the average frost-free period for the various parts of the county is 212 days annually. The temperature on Lookout, Sand, and Fox Mountains is slightly lower throughout the year than in the valley.

Soils of this county are light in color, because they have been developed under a forest cover that did not favor the accumulation of much organic matter in the soil. The best developed soils are on the well-drained ridges and terraces where soil processes have so modified the chemical and physical properties of the soil materials that the original geologic characteristics have, in part, given place to the subsequently developed true soil characteristics. These soils are podzolic in that leaching and the translocation of sesquioxides and particularly the removal from the solum of calcium and magnesium carbonates are dominant in the soil-forming processes. Where the land is gently sloping and is underlain with impervious layers, the soil characteristics, owing largely to poor or imperfect drainage, are not so well developed. About 60 percent of the land is steep, ranging from 15 to more than 30 percent slope. Erosion has kept pace with soil development so that well-developed soil profiles have not been formed. There are extensive areas of AC soils—Lithosols and shallow soils, such as Muskingum stony fine sandy loam and rough stony land. The A horizon in many places consists of a layer of dark material a few inches thick, and the B horizon throughout is largely disintegrated parent material. Thus, it is evident that parent materials and substrata play a very important role in the development of characteristics of soils of the steeper slopes.

According to their parent materials and physiographic relationships, the soils of this county may naturally be placed in three important groups: (1) Those developed from residual sandstone and shale materials on Lookout, Sand, and Fox Mountains, prevailingy featured by high tableland and steep slopes; (2) those developed from limestone, sandstone, chert, and shale materials of Lookout and smaller valleys where the relief ranges from undulating valley floors to steep narrow ridges and steep valley slopes; and (3) those developed from alluvial materials.

About 61 percent of the area of soils is derived from interstratified sandstone conglomerate and shale of the Pottsville formation, 15 percent from Bangor limestone, 5 percent from interstratified shale and sandstone, and 21 percent from beds of Fort Payne chert. About 19 percent represents transported material. Of this, 6 percent occupies alluvial fans, 5 percent occurs on stream terraces, and 8 percent in flood plains.

Through the processes of soil development, the surface soils developed from these soil materials have been reduced to a more uniform composition as regards texture and consistence. The more apparent characteristics have resulted from a thin accumulation of organic matter (the A_0 layer), development of a thin, dark-colored A_1 layer of mixed mineral material and humus, development of a thin gray A_2 layer indicative of maximum leaching, a relative accumulation of silica in the A horizon, and a translocation of fine materials and sesquioxides from the A horizon to the B horizon, as shown by the higher content of clay and more red coloration than occurs in either the A or C horizons.

These characteristics exist in the mature members of the first group—soils developed from residual sandstone and shale materials—and are partly developed in the members of the second and third groups—soils developed from limestone, sandstone, chert, and shale materials and soils developed from alluvial materials. For the purpose of discussion, a representative soil from each group will be described, after which its relation to other soils in the same group will be shown.

Table 8 shows the parent material and descriptions of the profiles of the soil series.

TABLE 8.—*Parent material and description of profiles of soil series in Dade County, Ga.*

Soil series	Parent material ¹	Description of profile
Hartsells.....	Walden sandstone and Lookout sandstone, composed of interstratified beds of sandstone, conglomerate, and shale.	Pale yellowish-gray fine sandy loam, A horizon; and yellow or brownish-yellow friable fine sandy clay, B horizon, 30 to 40 inches.
Muskingum.....	do.....	Grayish-yellow or yellowish-gray very fine sandy loam, A horizon; and yellow or reddish-yellow friable fine sandy clay, 9 or 11 inches. AC soil. Mainly rock-fragment outcrops of sandstone and limestone.
Rough stony land,	Walden sandstone, Lookout sandstone, Bangor limestone, and a small quantity of Pennington shale.	
Clarksville.....	Fort Payne chert, composed of beds of chert interstratified with clay and Knox dolomite. Some Devonian rock.	Gray cherty silt loams, A horizon; and yellowish-gray and grayish-yellow cherty silty clay loam, B horizon.
Fullerton.....	do.....	Light grayish-brown silt loam, A horizon; reddish-yellow to pale-red, heavy, brittle silty clay; interstratified beds of chert and clay.
Armuchee	Red Mountain formation, consisting of interstratified shale and limestone, some of the shale being calcareous.	Brown silt loam, A horizon; and reddish-brown brittle silty clay, B horizon. Below a depth of 40 inches are beds of shale interstratified with limestone.
Dewey-Waynesboro.	Red Mountain formation, consisting of interstratified limestone, sandstone, shale, and iron ore.	Reddish-brown silt loam, A horizon; deep-red pervious silty clay loam, B horizon; interstratified ferruginous sandstone, iron ore, shale, and limestone at 40 inches.
Hanceville.....	do.....	Brown friable fine sandy loam, A horizon; red heavy friable silty clay, B horizon; interstratified ferruginous sandstone, iron ore, shale, and limestone at depths ranging from 10 to 30 inches.

¹ Based on Geological Map of Appalachian Valley and Lookout Plateau of Georgia in the following publication: SMITH, RICHARD V. SHALES AND BRICK CLAYS OF GEORGIA. Ga. Geol. Survey Bul. 45, facing page 66. 1931.

TABLE 8.—*Parent material and description of profiles of soil series in Dade County, Ga.—Continued*

Soil series	Parent material	Description of profile
Colbert.....	Chickamauga limestone with thin beds of Athens shale.	Brownish-gray heavy silt loam, A horizon; and yellow impervious silty clay, B horizon.
Talbott.....	do.....	Grayish-brown silt loam, A horizon; brownish-red heavy silty clay, B horizon.
Allen.....	Old colluvial materials largely from sandstone, with some shale and limestone.	Brown loam, A horizon; and red friable clay, B horizon.
Jefferson.....	do.....	Brownish-gray or grayish-brown fine sandy loam, A horizon; and reddish-yellow sandy clay, B horizon.
Abernathy.....	Recent colluvial material largely from limestone and shale soils.	Brown friable silt loam to a depth of about 40 inches.
Sequatchie.....	Old alluvial materials largely from sandstone.	Grayish-brown fine sandy loam, A horizon; and yellowish-brown or reddish-brown fine sandy loam or loam, B horizon.
Etowah.....	do.....	Brown silt loam, A horizon; brown silty clay loam, B horizon.
Pope.....	Recent alluvial materials largely from sandstone and shale.	Brown, friable silt loam to a depth of 3 to 4 feet.
Atkins.....	do.....	Gray or brownish-gray silt loam to a depth of 10 inches. Below this is gray silt loam, with yellow or brown mottlings, continuing to a depth of 40 inches or more.
Philo.....	do.....	Grayish-brown very fine sandy loam to a depth of 20 inches or more and gray mottled with yellow or brown very fine sandy loam or silt loam below.

Figure 2 outlines the area of the geological formations indicated in table 8 and gives the geological periods during which these formations were formed.

A virgin soil profile of Hartsells very fine sandy loam, $3\frac{1}{2}$ miles west of Trenton, is representative of the first group. This profile was taken on a gentle ridge slope where both surface and internal drainage are good. From the surface downward, the profile of this soil, in the air-dried condition, may be described by layers as follows:

- A₀. 0 to $\frac{1}{2}$ inch, surface covering of dark-gray organic matter composed of leafmold, litter, and humus. The pH value is 6.4.²² This pH value when compared with the low pH values of the rest of the solum, suggests that calcium carbonate has been carried from the underlying limestone to the roots and has been deposited in the leaves.
- A₁. $\frac{1}{2}$ to $2\frac{1}{2}$ inches, mixed mineral and organic matter—gray very fine sandy loam that, in many places, shows a laminated structure. The pH value is 5.3.
- A₂. $2\frac{1}{2}$ to 16 inches, the layer of maximum leaching, which consists of pale yellowish-gray very fine sandy loam. This material breaks into single grains but when shaken out clings in small lumps to rootlets. Numerous streaks of gray material reach down from the overlying layer where it has sifted down through old root channels and worm burrows. The pH value is 5.4.
- A₃. 16 to 18 inches, gray finely vesicular friable loam that in the lower part is more of a grayish brown and a little heavier textured, indicative of its transition to the illuvial horizon. The pH value is 5.5.
- B₁. 18 to 33 inches, hard brittle vesicular clay loam, which breaks readily into irregular-shaped blocks, ranging from 1 to 8 mm. in diameter. The brown to reddish-brown color is more pronounced within the blocks. The brown to reddish-brown color and heavier texture show the accumulation of iron and fine material, both of which characterize the illuvial horizon. Many gray streaks, where the iron has been reduced, are apparent along root channels. The pH value is 5.2.

²² All pH determinations given in the text of this section of the report were made by G. D. Thornton, using the Morgan colorimetric method.

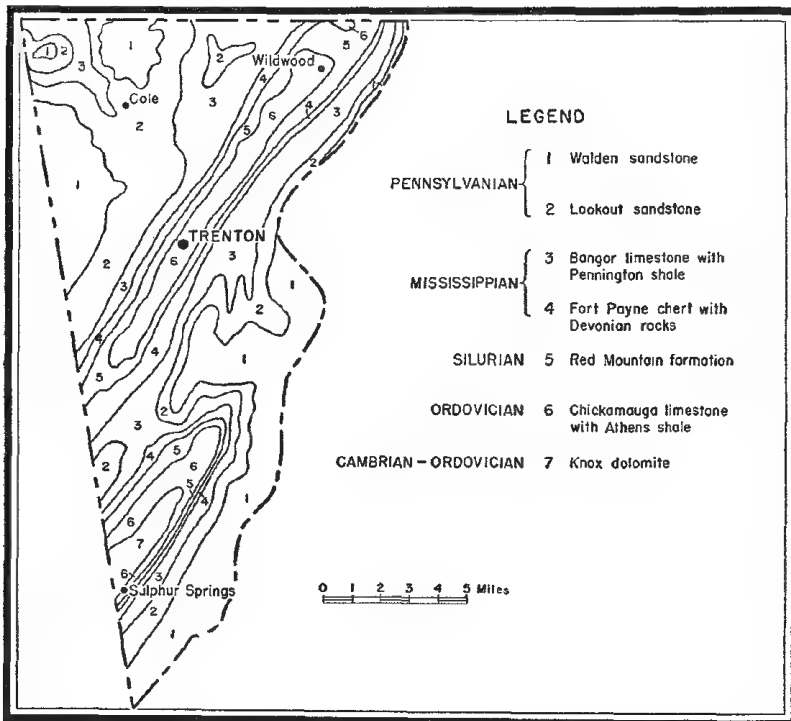


FIGURE 2.—Geological formations and geological periods during which these formations were formed in Dade County, Ga. Based on the geological map of the Appalachian Valley and Lookout Plateau of Georgia (see footnote 1, table 8).

- B. 33 to 58 inches, material that has a more pronounced red color, a somewhat heavier texture, and that breaks into slightly larger irregular-shaped lumps than the material in B. The surface coating of the lumps range from reddish brown to brownish red, and their interiors are yellow. The pH value is 5.2.
- C. 58 to 66 inches, variegated yellowish-red, yellow, or red parent material having a friable silty clay loam texture. The pH value is 5.2.
- C. 66 to 78 inches, a substratum of interstratified thin-bedded sandstone and shale.

Many roots are present throughout the soil mass, and the larger ones penetrate the underlying formation.

Fullerton silt loam is representative of the well-drained soils derived largely from chert and limestone, which have less pronounced relief than do the soils of the first group. This soil occurs throughout Lookout Valley on lower ridges underlain by a chert formation. A typical profile of this soil observed 1 mile west of Trenton may be described as follows:

- A. 0 to $\frac{1}{2}$ inch, a thin layer of dark-brown forest mold and litter. The pH value is 6.0.
- A. $\frac{1}{2}$ to 7 inches, light grayish-brown laminated friable silt loam with some organic matter that is well united with the mineral particles.
- A. 7 to 15 inches, light-yellow highly leached friable silt loam that breaks down to single grains.

- B₁. 15 to 24 inches, reddish-yellow friable vesicular silty clay loam with some small angular chert fragments. The material breaks into small angular aggregates, ranging in diameter from one-eighth to three-eighths of an inch. As a rule, the color of the outsides of the aggregates is reddish yellow, but that of the insides is yellowish brown or brownish yellow. The pH value is 5.5.
- B₂. 24 to 60 inches, pale-red compact brittle silty clay mottled with grayish yellow. The material of this layer readily breaks into irregular-shaped aggregates, ranging from one-fourth to one half inch in diameter. Throughout this layer are more or less angular chert fragments from $\frac{1}{4}$ to 10 inches in diameter.
- C₁. 60 to 90 inches, interstratified beds of folded chert and heavy red clay.

Throughout the soil mass and scattered over the surface are small irregular-shaped fragments of chert.

Associated with the Fullerton soils are soils of the Clarksville, Colbert, Talbott, Armuchee, and Dewey-Waynesboro series. The soils of the first series are like the Fullerton soils in that they are composed largely of residual material from chert, whereas soils of the Colbert and Talbott series are from limestone; the Armuchee soils are dominantly from shale interstratified with limestone; and the Dewey-Waynesboro soils are from interstratified beds of limestone, shale, sandstone, and iron ore.

The Clarksville soils occur on steep ridge slopes and crests where erosion has retarded soil development. Their A horizons are gray cherty silt loams, and their B horizons are yellowish-gray and grayish-yellow cherty friable clay loams. The Colbert soils are gray silt loams. They occur on smooth, gentle slopes. At a depth of 10 or 12 inches the material is heavy silty clay.

The Talbott soils occur on ridges and have somewhat more sloping relief than the Colbert soils. The surface soil is grayish brown, and the subsoil is brownish-red heavy silty clay but it is not impervious and does not restrict drainage and soil-forming processes as does the corresponding layer of Colbert silt loam.

The Armuchee soils occur on gentle to steep ridge slopes, but, on the whole, the percentage of slope is higher than on the Colbert or Talbott soils, lower than on the Clarksville soils, and averages about that of the Fullerton soils. Its B horizon is thinner, however, than that of the Fullerton soils and thicker than that of the Colbert soils, owing to more restricted internal drainage than the former and less restricted drainage than the latter.

The Dewey-Waynesboro soils resemble the Fullerton soils in having good drainage throughout and a thick B horizon. They differ from those soils in having more sloping surfaces, reddish-brown surface soils, deep-red to maroon-red subsoils, and higher water-absorbing and water-holding capacities.

The better drained soils occurring on stream terraces and alluvial fans closely resemble the Fullerton soils in that they have grayish-brown or brown surface layers and reddish-yellow or yellowish-red pervious friable B horizons. They differ chiefly in their parent material or substrata layers.

The essential characteristics of a well-drained soil of the terraces are shown by the profile of Etowah silt loam as it occurs in a road cut $1\frac{1}{2}$ miles northwest of New England:

- A₁. 0 to 7 inches, rich-brown silt loam with organic matter that is well combined with the mineral particles.
- A₂. 7 to 13 inches, brown mellow silt loam.

- B. 13 to 25 inches, brown silty clay loam, which breaks into structural aggregates ranging from $\frac{1}{8}$ to $\frac{1}{2}$ inch in diameter.
- C. 25 to 45 inches, yellowish-brown or brownish-yellow compact, brittle, heavy silty clay loam or light silty clay material.
- C₂. 45 to 57 inches, mottled brownish-yellow, yellowish-brown, or yellow silty clay material with black surface coatings on particle faces.
- C₃. 57 to 66 inches, the substratum of mottled gray and yellow gravelly silty clay. The gravel is stratified, and clay has filled the interstices.

Other soils occurring on the terraces belong to the Sequatchie series. These soils are more pervious throughout than those of the Etowah series.

The Allen and Jefferson soils are developed on alluvial fans along the east side of Lookout Valley and along the base of Lookout Mountain. The Jefferson soils occur also in Egypt, Murphy, and Cole City Hollows. The soil materials of these series came largely from debris blanketing the sandstone, conglomerate, and limestone of the steep valley slopes of Lookout and Sand Mountains. Scattered over the surface and impregnating the soil throughout are numerous sandstone and conglomerate cobbles and boulders, ranging from 3 inches to 4 feet in diameter. Allen loam has a brown loam surface layer underlain by dull-red friable loam, which grades downward into red friable clay loam and clay. Jefferson fine sandy loam is brownish-gray or grayish-brown fine sandy loam in the A horizon and yellow or reddish-yellow fine sandy clay in the B horizon.

Colbert silt loam, colluvial phase, occurs on alluvial fans along intermittent streams and in shallow depressions throughout Lookout Valley. The soil materials have been washed largely from soils and materials overlying limestone and shale and, to less extent, from soils and materials underlain by sandstone and chert. This soil differs from the Allen and Jefferson soils in its heavier texture throughout, poorer internal drainage, and consequently more or less restricted soil development. The A horizon is light brownish-gray or light grayish-brown friable silt loam. The B horizon consists of brownish-gray or brownish-yellow rather heavy but friable silty clay with many iron concretions of buckshot size.

On the stream flood plains and in the depressions, definite soil characteristics have not developed. The well-drained soils of the flood plains are classed as Pope soils, the intermediately drained as Philo, and the poorly drained as Atkins. In Lookout Valley materials making up these soils are washed from soils overlying limestone, shale, chert, sandstone, and conglomerate; whereas on the mountains they are washed from soils underlain by sandstone, conglomerate, and shale.

The Abernathy soils differ from those of the flood plains in that they occupy depressions. They are brown silt loams, with splotches of grayish brown below 40 inches, and are well drained. They occur in Lookout Valley and represent wash mainly from soils underlain by limestone and shale.

Results of mechanical analyses, chemical analyses, and analyses of colloids of a sample of Fullerton cherty silt loam from Cherokee County, Ala., are given in tables 9, 10, and 11. Cherokee County lies about 15 miles south of Dade County. It is believed the data presented in these tables apply equally well to the Fullerton soils of Dade County.

TABLE 9.—*Mechanical composition of samples taken from a profile of Fullerton cherty silt loam collected in Cherokee County, Ala.*¹

Sample No.	Horizon	Depth	Fine gravel (2-1 mm.)	Coarse sand (1-0.5 mm.)	Medium sand (0.5-0.25 mm.)	Fine sand (0.25-0.1 mm.)	Very fine sand (0.1-0.05 mm.)	Silt (0.05-0.002 mm.)	Clay (<0.002 mm.)	Organic matter by H ₂ O ₂	Material (<0.005 mm.)	pH
		Inches	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	
C-107	A ₂	0-9	7.4	5.6	4.3	10.0	11.4	51.1	9.4	0.4	17.5	5.1
C-108	B ₁	9-20	4.2	1.0	2.0	3.9	4.8	50.3	31.2	.3	44.2	4.4
C-109	B ₂	20-32	1.8	1.2	1.8	1.0	2.8	43.3	49.3	.1	57.9	4.4
C-110	B ₃	32-53	2.5	2.0	1.0	1.7	3.3	36.5	52.6	.2	61.9	4.4
C-111	C	53-74	5.1	4.7	2.6	3.5	3.2	26.4	54.5	.0	63.9	4.6

¹ Taken from the following publication: ALEXANDER, LYLE T., BYERS, HORACE G., and EDGINGTON, GLEN. A CHEMICAL STUDY OF SOME SOILS DERIVED FROM LIMESTONE. U. S. Dept. Agr. Tech. Bul. 678, 26 pp. This soil originally was correlated as Fullerton gravelly loam, but it has now been established as Fullerton cherty silt loam.

TABLE 10.—*Chemical composition of samples taken from a profile of Fullerton cherty silt loam collected in Cherokee County, Ala.*¹

Sample No.	Horizon	Depth	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	K ₂ O	Na ₂ O	MnO	P ₂ O ₅	SO ₂	Ignition loss	Total	Organic matter	Nitrogen
		Inches	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
C-107	A ₂	0-9	91.25	3.03	1.32	0.57	0.07	0.16	0.32	Trace	0.04	0.06	0.05	2.69	99.56	1.67	0.07
C-108	B ₁	9-20	85.53	7.30	2.61	.64	.17	.25	.37	-.do.	.02	.03	.04	2.98	99.94	.41	.03
C-109	B ₂	20-32	76.59	12.48	4.15	.58	.13	.46	.71	0.03	.02	.02	.10	4.82	100.09	.36	.03
C-110	B ₃	32-53	73.00	13.96	5.20	.60	.15	.58	.79	.03	.02	.01	.08	5.47	99.89	.34	.03
C-111	C	53-74	67.84	15.75	7.96	.61	.09	.56	.96	Trace	.03	.01	.08	6.23	100.17	.26	.02

¹ Taken from U. S. Dept. Agr. Tech. Bul. 678 (see footnote 1, table 9).

TABLE 11.—*Chemical composition of colloids extracted from samples taken from a profile of Fullerton cherty silt loam collected in Cherokee County, Ala.*¹

Sample No.	Horizon	Depth	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	K ₂ O	Na ₂ O	MnO	P ₂ O ₅	SO ₂	Ignition loss	Total	Organic matter	Nitrogen
		Inches	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent
C-107	A ₂	0-9	46.71	25.83	7.78	0.67	0.42	0.80	0.86	Trace	0.08	0.44	0.19	16.39	100.17	6.42	0.51
C-108	B ₁	9-20	48.30	27.52	9.57	.87	.28	1.07	1.08	-.do.	.02	.14	.05	10.95	99.85	1.18	.10
C-109	B ₂	20-32	48.79	27.19	9.33	.89	.15	1.07	1.28	-.do.	.01	.09	.05	10.20	100.04	.79	.06
C-110	B ₃	32-53	50.46	27.11	9.08	.83	.17	.97	1.26	-.do.	.01	.03	.02	10.09	100.03	.65	.05
C-111	C	53-74	46.21	30.04	9.76	.71	.10	.91	1.48	-.do.	.01	.09	Trace	10.92	100.23	.41	.24

¹ Taken from U. S. Dept. Agr. Tech. Bul. 678. (See footnote 1, table 9.)

SUMMARY

Dade County lies in the extreme northwest corner of Georgia bordering Alabama on the west and Tennessee on the north. It is one of the small counties in the State. Lookout and Wills Valleys extend diagonally across it in a northeast-southwest direction. These valleys range in elevation from 680 to 1,300 feet above sea level, and in relief from almost level or undulating to rolling and hilly. They

are flanked on the east by Lookout Mountain, which reaches an elevation of from 1,700 to 2,200 feet. Fox Mountain rises west of Wills Valley. Sand Mountain rises west of Lookout Valley and ranges in elevation from 1,300 to 1,600 feet. The mountaintops are dominantly smooth, but the sides are steep and in places precipitous. Drainage waters for the greater part of the area flow northeast into the Tennessee River.

The climate is characterized by moderately long summers and short mild winters. The average frost-free season covers a period of about 212 days. The average annual rainfall is nearly 52 inches. The temperature is somewhat lower throughout the year on the mountains than in the valleys.

Many different soils are mapped, owing to the varied rock formations. In the valleys limestones, cherty limestones, and calcareous shales underlie the soils; whereas the mountaintops are underlain by a thick layer of sandstone, with some conglomerate and shale. All the upland soils have developed through the soil-forming processes from the weathered products of the underlying rocks. Some translocations of materials have taken place giving rise to soils developed from old colluvial materials. The second bottoms and remnants of old terraces represent sediments laid down by Lookout Creek when it flowed at a higher level; narrow strips of recent alluvial deposits border the streams on the first bottoms or flood plains. The soils on both the second bottoms and on first bottoms consist of sediments washed from soils underlain by sandstone, shale, limestone, and cherty limestone.

In the valleys the upland soils are underlain by limestone, cherty limestone, and shale, and are dominantly silt loams in texture. The surface soils range in color from light gray to brown or red, whereas the subsoils range from red moderately friable silty clays to yellow heavy impervious clays. On the mountains the soils have light-gray or grayish-yellow fine sandy loam and very fine sandy loam surface soils and yellow friable fine sandy clay or clay loam subsoils. These soils are developed from sandstones, with a small amount of conglomerate and shales.

All the soils, with the exception of some of those on the first bottoms have good surface drainage. Internal drainage, particularly of the subsoils, depends on the texture, structure, and consistence of the material and ranges from good to very slow. Most of the soils are deficient in organic matter and are acid to strongly acid in reaction. Sheet erosion and some gullying are active in many of the areas that have been under clean cultivation for a long time; and, as a result, in some places a part or nearly all of the original surface soil has been removed.

The soils of Dade County have been grouped into four classes; that is, two classes of cropland, one class of pasture land, and one class of forest land. In placing the soils in one of these four groups, the following factors as regard their agricultural value, productivity, and use were given consideration: Internal characteristics of the soil, such as texture, structure, and consistence that favor tilth; relief, or lay of the land; drainage; erosion; workability of the soils; ability of the soils to absorb rainfall and retain moisture for use by the crops; stoniness; depth to bedrock; content of organic matter; and inherent fertility. A soil may be fertile and yet not productive because of

some one or more unfavorable factors which preclude its use for farming.

In the first group, which is designated Second-class soils because there are no strictly First-class soils in this county, are Fullerton silt loam; Fullerton silt loam, slope phase; Talbott silt loam; Dewey-Waynesboro silt loams, eroded phases; Armuchee silt loam; Hartsells fine sandy loam; Hartsells very fine sandy loam; Etowah silt loam; Etowah silt loam, eroded phase; Sequatchie fine sandy loam; Allen loam; Colbert silt loam, colluvial phase; Abernathy silt loam; and Pope silt loam. Considering all factors as related to production, at present these soils possess more of the favorable characteristics and are the best soils in the county. In many instances a larger percentage is under cultivation and the yields are higher under both natural conditions and also under improved methods of management than any other soils for the county as a whole. It is true that under special treatment and management for some particular crop some of the soils in the next group may excel in production over a soil in this group.

Third-class soils include the following types and phases: Colbert silt loam; Fullerton silt loam, eroded phase; Fullerton silt loam, eroded slope phase; Clarksville cherty silt loam; Jefferson fine sandy loam; Etowah silt loam, eroded slope phase; Pope fine sandy loam; and Philo very fine sandy loam. The soils of this group have fewer of the favorable features or more of the undesirable qualities than the soils in the preceding group. They may be seriously eroded or occur on steeper slopes, they are more expensive to handle, and the yields are prevailingly lower compared with those soils. A considerable percentage of these soils is under cultivation, and a large acreage could be devoted to crop production.

Fourth-class soils comprise the following: Colbert silt loam, slope phase; Colbert silt loam, hill phase; Colbert silt loam, shallow phase; rolling stony land (Colbert soil material); Fullerton silt loam, hill phase; Clarksville cherty silt loam, hill phase; Hanceville silt loam, hill phase; Armuchee silt loam, hill phase; Armuchee silt loam, eroded phase; rough gullied land (Colbert and Armuchee soil materials); and Atkins silt loam. Practically all of the soils in this group represent eroded phases, slope phases, and hilly phases of the typical soils. Such unfavorable features rank them as Fourth-class soils, or pasture land. These soils do not support so good pasture grasses as do the soils in the Second- and Third-classes; but they are not desirable soils for cultivated crops, although, by proper management, they may be used for pasture grasses. Nevertheless, a small percentage of some of these soils is under cultivation, and, even under changed economic conditions or greater demand for certain crops, more of these lands might be brought under cultivation.

Fifth-class soils, or forest land, include the following soil types and phases: Jefferson stony fine sandy loam; Hartsells fine sandy loam, slope phase; Hartsells fine sandy loam, shallow phase; Hartsells fine sandy loam, shallow slope phase; Hartsells very fine sandy loam, slope phase; Muskingum stony fine sandy loam; smooth stony land (Hartsells soil material); rough stony land (Muskingum and Hanceville soil materials); and rough stony land. These soils and phases by reason of their steepness of slope, stoniness, nearness of bedrock to the surface, and outcrops of solid rock are unsuited for pasture grasses or farm crops except in small patches here and there. Evidently these

soils and phases are not so well suited to the growing of trees as the other soils in the county, but forestry is their best use at present.

Mine dump represents a miscellaneous classification of material that has no agricultural value.

Most of the farming operations are confined to the smoother land in Lookout and Wills Valleys and on the tops of Lookout and Sand Mountains. A considerable part of the best agricultural land in the valleys has been cleared, and some of it has been under cultivation for more than 100 years. The soils on Sand and Lookout Mountains, however, have been cleared and farmed only since about 1900. Many acres of land in the valleys and a much smaller area on the mountains that once were farmed, have now been abandoned and allowed to reforest to oaks and pines, or to grow up in bushes, briars, and sedges. Steep mountainsides and the rough stony land comprise a large acreage. Some large tracts of land on the mountains are held by lumber companies.

There is a direct relation between the soils that possess favorable features and the agriculture of the county. At present the agriculture consists of the growing of corn, cotton, wheat, and lespedeza hay as the main crops. The secondary crops are soybeans, cowpeas, oats, peanuts, apples, peaches, potatoes, sweetpotatoes, and turnips. A little dairying is carried on; few cattle, hogs, and poultry are raised; and garden vegetables are grown.

On Hartsells fine sandy loam, Hartsells very fine sandy loam, and their phases on tops of the mountains are produced most of the apples, peaches, sweetpotatoes, and turnip greens, as well as a considerable amount of hay and cotton. Abernathy silt loam; Pope silt loam; Colbert silt loam, colluvial phase; and Philo very fine sandy loam are devoted mainly to the production of corn and hay. High yields of these crops are obtained under favorable conditions. This is due in a large measure to the favorable moisture condition of the soils, their inherent fertility, and the content of organic matter. Fullerton silt loam; Allen silt loam; Etowah silt loam; Dewey-Waynesboro silt loams, eroded phases; and Sequatchie fine sandy loam are the best soils in the valley for the production of cotton. Talbott silt loam, Armuchee silt loam, and, to less extent, Colbert silt loam are considered good soils for the growing of wheat, cotton, and lespedeza and also for corn where there is a sufficient supply of organic matter. Clarksville cherty silt loam is well suited to lespedeza, strawberries, and peaches.

Many of the soils in the valley and much of the Hartsells soils on the mountains can be built up to a fair or even high state of productivity, and this productivity can be maintained easily by growing and turning under leguminous crops, such as soybeans, cowpeas, lespedeza, and crimson clover. An opportunity exists for expanding farming operations on the mountains, as a considerable acreage of Hartsells fine sandy loam is undeveloped. Some of the land in the valley, that is now idle or has been reforested, can be reclaimed for agricultural purposes. The northern end of Dade County is only 6 or 8 miles from the city of Chattanooga, a good market for garden vegetables, fruits, dairy products, chickens, eggs, and home-dressed pork and beef.

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